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ABSTRACT

"Understanding Adult Intelligence" (Robert Sternberg) focuses on the nature of intelligence. It explains Sternberg's triarchic theory, in which he posits three main aspects of intelligence: its relation to the internal or mental world of the learner, its relation to experience, and its relation to the surrounding world. "Strategies and Learning" (Claire Weinstein) presents a brief overview of the kinds of learning strategies that have been identified that differentiate between more and less successful learners. A brief introduction is also given to an instrument used in a learning-to-learn course that helps to give some assessment of where students are in this area. "Reaction to Presentations: A Panel of Adult Education Professors" (Huey Long et al.) offers comments in an attempt to give focus to further discussions of intelligence and learning strategies. "Real Life vs. Academic Problem Solving" (Robert Sternberg) discusses the difference between everyday problems and academic or test-taking problems. The differences are that academic problems are prerecognized, predefined, and well-structured; most school problems have one right answer; academic problems provide relevant information; in school settings, there is clear feedback; and schools emphasize individual problem solving. (YLB)

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ADULT LEARNING RESEARCH

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Intelligence

and

Adult Learning

Intelligence and Adult Learning

Papers from an Institute Sponsored by
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Montana State University
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Editors
Robert A. Fellenz
Gary J. Conti

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Foreword

Intelligence has been a troublesome construct for adult educators. Most research studies on the subject have examined the development or levels of intellectual ability in children, adolescents, or occasionally college students. Those few studies directed toward mature learners often demonstrated a basic bias regarding aging and ability by framing problems in a negative mode, such as questioning which intellectual abilities remained constant through adulthood or at what age intelligence began to decline. For the practitioner, applications of theory on intelligence to adult learning situations was frustrating. Prior experience, value sets, and perceived needs appeared to impact much more significantly on learning than vague motions of intellectual ability. Admittedly, formal education programs did use intelligence tests for admission purposes, but many teachers witnessed little correlation between such scores and learning in the classroom. Thus, over both research and practice hung the troublesome connotation that intelligence studies suggested that old dogs had trouble learning new tricks.

But things have begun to change. During the past decade theorizing on intelligence has added a new dimension. Information processing approaches to the analysis of intellectual abilities have opened two avenues of study that are particularly relevant to those working with adult learners. The first is a shift from the analysis of factors that comprise intelligence to an examination of the many ways in which intelligence is applied. This naturally has led to a study of intelligence in real-life situations.

Robert Sternberg is definitely a leader in this effort to analyze intellectual ability in its relationship to adult life. In his triarchic theory he has posited three main aspects of intelligence: (a) its relation to the internal or mental world of the learner, (b) its relation to experience, and (c) its relation to the surrounding world. His relation of intelligence to the inner world correlates to the traditional approach of analyzing the components involved in mental processes; but with an information processing stance and an insistence that real-life applications be taken into account. The experiential subtheory concentrates on the ability to react to situations with relative novelty and to automatize certain aspects of information processing. The third aspect of intelligence concerns the ability to react to the external world or context of the individual. The three processes Sternberg identifies here are adaptation to, shaping of, and selection of environments.

The application of intellectual functions to learning in the real world opens for examination various areas relevant to adult education. For example, it moves the whole discussion of intelligence from centering on children in formal school settings to adults and the sweeping aspects of learning and living. Moreover, if intelligence is comprised not solely of internal mental components acquired through heredity, educators may be able to effect increases in intellectual ability. Great ramifications for continuing professional education, for adult basic education, and for adult development are inherent in this. Explanations of the decline of intellectual ability in aging and that disturbing concept of crystallized and fluid intelligence which are linked to that limited concept of intelligence as solely internal also are open to reexamination and reinterpretation. But what may be even more important to adult educators is that the whole realm of learning how to learn is elevated in importance.

Claire Weinstein believes that adults can be taught learning strategies that will improve their ability to learn. She has not only provided leadership to the conceptualization of learning strategies but has also developed a device to measure the degree to which students use such strategies. Although her work at the University of Texas has been mainly with undergraduate students, she sees great potential for the application of learning

strategies by adults to their daily learning tasks. Her work also has application to self-direction in learning for it gives the independent learner a scheme for evaluating their learning processes.

The papers included in this monograph were presented to a group of adult education professors at a summer institute held at Montana State University in August of 1988. Sternberg and Weinstein both made formal presentations and interacted in small group sessions with the adult educations. Several days were spent discussing the application of these concepts to theory and practice related to adult learning. An additional resource available to institute participants and to readers of this monograph was the annotated bibliography assembled by Jeri Hosick and Linda Loehr, graduate students working with Rosemary Caffarella at Virginia Commonwealth University. Both the institute and this monograph were sponsored by the Center for Adult Learning Research and were supported by a grant from the W.K. Kellogg Foundation.

---Robert A. Fellenz

Understanding Adult Intelligence

Robert J. Sternberg

The topic of my talk is the nature of intelligence, and I would like to explain my triarchic theory. I will start with a story that I think illustrates the basic precepts of the theory. If you get the story, you will get some of those precepts and some practical information about intelligence.

Two college students are walking in the forest. As they walk they encounter a problem. The problem is a big, ferocious looking grizzly bear coming at them. The first of the guys is somebody who is considered very smart in terms of standard conceptions of intelligence. His IQ is very high; his ACT scores are very high; his teachers think he is really smart; his grades in school are very high. He looks very good in terms of intelligence in almost any way you can think of; in fact, he shows that he is very good by calculating that the grizzly bear will overtake them in 7.3 seconds. He is able to manipulate the time, the rate, the distance and use the formula to figure that out. He does the calculation and understandably panics because he realizes it looks very grim. He looks over at the second guy who is not very smart by any of the usual testing standards. His ACT scores aren't very good; his teachers don't think he is very smart; his grades aren't that good. The best you could say about him is that he is kind of shrewd or he has a lot of common sense. The first guy notices with disgust that the second guy is not panicking and he doesn't even seem to be scared. In fact, he's taking off his hiking boots and putting on jogging shoes. So the first guy says to the second guy, "You must be crazy. You'll never be able to outrun that grizzly bear." The second guy says to the first guy, "That's true; but all I have to do is outrun you!" The result, of course, is that the first fellow gets eaten alive and the second guy jogs off to safety. His kind of intelligence proved to be somewhat adaptive for the purposes needed.

I'll tell you the sequel to the story. Understandably, the second fellow who lived acquired a phobia of grizzly bears. He didn't want to go back up to the mountains but he realized that wasn't practical because of where he lived. Being shrewd, he decided that the only way to handle the problem was to go back up into the mountains and do deep relaxation and self-suggestion until he overcame the fear of grizzly bears. So that's what he did; he went back to the forest and he did deep relaxation and hypnotised himself and began to feel the fear of grizzly bears starting to leave him. As he was relaxing, he was warned of another true example of adult education, and that was whereas lightning never strikes twice in the same place; grizzly bears often do. As he was relaxing, a grizzly bear came pounding at him. He realized he couldn't outrun the first guy because that guy was dead. He couldn't climb a tree because, although with fake stories there's always a tree you can climb, in true ones like this, you can't get up there in time. Nothing seemed to be working. Finally he decided that he would do what was left to him which was to get down on his knees and pray. He prayed that the grizzly bear would become a good Christian like himself. It worked somewhat because just as the grizzly was about to attack and eat him alive, the bear got down on its haunches and started to pray. It prayed, "I thank the Lord for the offering I'm about to receive." And that was the end of the second boy.

The point, of course, to these little vignettes is that there seems to be more to intelligence, whether it's adult intelligence or practical intelligence, than what you would measure by standard tests. The question one would want to deal with is, what is intelligence in the broad sense?

The question of "what is intelligence" was originally addressed by Alfred Benet in France at the turn of the century. He was asked to devise a test that would distinguish kids who were mentally retarded from kids who were behavior problems. The problem was that the teachers were putting kids with

behavioral problems in with the mentally retarded kids because they wanted to get the kids out of their classes. That was a fairly auspicious beginning, but it had a somewhat unpleasant consequence in that intelligence came to be defined as related to what was done in school. Academics is only part of the story of intelligence.

Throughout most of this century, the popular definition of intelligence has been that intelligence is what IQ tests test. So that has basically been the going view of intelligence. Not that many people would admit that; but they nevertheless acted as though it was true. If you were in a school system with a gifted program, they wouldn't say that what you needed to get into the program was an IQ of 130, but in fact that's very likely how they operated. What it gets down to is that to be considered intelligent you have to do well on these tests. In fact, you can't gain access to higher education, as I'll argue again later, without doing well on such tests.

In the 1970s a group of us, who call ourselves cognitive psychologists, began to feel that this definition was somehow wrong, that we were missing something in terms of understanding what intelligence really is. Our conclusion (people like Earl Hunt, Jack Carroll, Jim Pelegrino, Bob Glaser, and myself) was that what was missing in terms of understanding intelligence was an understanding of the mental processes that underlie intelligence. In other words, the tests can give you a score, but what they don't give you is an understanding of the mental processes that underlie the score. What we wanted to find was what these mental processes are? Why would we want to know what the mental processes are?

What I'd like to argue is that for practical as well as theoretical reasons, you really ought to understand how the person went about solving the problems. Let me give you a couple of examples. All of you are familiar with the kind of problem that appears on intelligence tests, namely verbal analogies, A is to B as C is to D. In an example of a verbal analogy you could have: "four score and seven years ago" is to Lincoln as "I'm not a crook" is to, and multiple choice answer options might be...Al Capone, Loren Harding, Richard Nixon and John Mitchell. The idea is you have to see the higher one in the relation, the one that relates the first half to the second half. If you think about that verbal analogy, you realize right away that in order to get it right you not only have to be a decent reasoner, but have to know something about American history, both the 1800s and recent American history. It turns out that if you look at the verbal analogies on most of the intelligence tests, it's the same. In order to get the analogies right on the verbal SAT, for example, or GRE, you really have to know a lot of vocabulary. You are more likely to get the analogy wrong because you don't know what the words mean than because you don't know how to read some of the terms. To do well on the Miller Analogies Test, which is 100 analogies, you not only have to be a good reasoner but you have to have a good vocabulary; you have to know something about Greek mythology, math formulas, physics formulas, fine wines, and so forth. That has an implication. The implication is that if you don't have a good score on this test, it could mean that you're not a good reasoner, but it could also mean you don't have the background information. You don't know about fine wines, Greek mythology, math formulas, physics formulas, or whatever.

If you're screening people with diverse backgrounds, you really want to know whether they did not do well on the test because they don't have the background or because they can't reason well. The diagnostic implications are totally different. All you have to do is give the Abraham Lincoln/Richard Nixon analogy in a foreign country and no one knows what you're talking about. It's not that they're stupid; it's just that they don't have that particular background. When you look at verbal analogies or other kinds of verbal items, on virtually any of these tests, you do not really know what you're measuring and you can make incorrect predictive and diagnostic inferences.

Let's take a completely different domain, spatial relations. A lot of intelligence tests will

have spatial relations questions in which a figure is given and you have to say which of the figures in another set can be rotated into congruence with the given figure. In other words, sometimes they're mirror images, sometimes they're not. You have to be able to distinguish the mirror images from the ones that are just rotation. That kind of item is used on the SRA Primary Mental Abilities and many other intelligence tests.

The reason that kind of problem is of interest to me is that I used to do very poorly on these tests; I have never been good at spatial relations. Two weeks ago I was in Israel and was supposed to go to someone's house which was five minutes from the hotel. It took me an hour and 15 minutes to find his house. What was really bad is that I had a map. Spatial location tasks are something that I find very hard. Predictably, I did quite poorly on them in elementary school, but in high school I found I could drastically increase my score. I realized that I could solve a lot of these problems verbally; I didn't even do the mental rotation. For example, you might say that this looks like a triangle with a dot in the middle, and you start talking your way through the problem. You can't do it for every spatial relations problem but you can do it for enough of them so that you can increase your scores substantially if you happen to be higher verbal than you are spatial. So, you could have two people taking a spatial relations test, one of whom solves the problems verbally while the other solves them spatially. They could have the same score, but the two scores would not mean the same thing at all. If you were in job placement, you would want to know whether the person was solving the problems verbally or spatially, especially if you were picking pilots or certain kinds of mechanics who may be able to solve the problems verbally on a test, but who would not be able to do it in the air when responsible for 400 passengers. So again, unless you understand the mental processes that underlie the test scores, you can draw conclusions that are wrong.

For a number of years we did these process analyses of intelligence test scores. But instead of having just an IQ score, we knew what processes the person used to solve the problems, what strategies they combined those processes into, how they represented that information, how long each of the processes took, and so forth. We really had a good idea of the information processing underlying the test. For several years I thought that this was a big deal; then I came to the conclusion that it was not that big a deal at all. We were still missing something fundamental in terms of understanding intelligence. I came to that conclusion by looking at what was actually happening in our graduate program. I had been director of graduate studies in psychology for a number of years so I was very involved with the testing program. One of the things I saw happening again and again was that we would admit people with very, very high GRE scores. But when they got into the program I would be convinced that they had either cheated on the test, had someone else take it for them, or had brain damage over the summer. The person who came into the program did not seem to be the person who had taken the test, and their performance just was not what we thought it would be. There were enough such cases that I became concerned.

You can say, maybe it's motivational. After all, intelligence doesn't account for everything. Of course it doesn't; we do get people with motivational problems. But a lot of these students seemed to be trying; they just did not seem real smart when it got down to using whatever the tests were measuring. The question became: Why is it that these people test well, but when you hire them, they're duds? That was the beginning of my thinking about the triarchic theory and the way the triarchic theory really came about.

I'm going to say a little bit more about three students because to understand their pattern of abilities is to understand my theory.

The three students are Alice, Barbara, and Celia. I've changed their names, but they are real students

Alice-Type Learners

Alice is a student like the first boy in the

forest story. She is somebody who came into the graduate program with all the right credentials. Her GRE scores were over 800, she had a 3.98 academic average, and her letters of recommendation were excellent. Everything about her on paper was just superb and, of course, we admitted her. She was our top pick that year. Well, the moral of the story is not that Alice was a bomb; she wasn't really bad. To the contrary, during her first couple of years she was great. She was really great at exactly what it was that the test measured. If you gave her a multiple choice test she did very well on it. If you had her write a typical academic paper where you summarize what other people say and at the end have a so-called "creative paragraph," she did very well. If I wrote a paper and wanted someone to tear it to shreds, I'd give it to Alice. She'd tear it to shreds--and that was before Ollie North made that a national pastime. She was very sharp analytically. She could take an argument and find any flaws that existed in it. Her memory skills were good; her analytical skills were good, she was what the test said she would be. During the first couple of years she was one of the top two students in the program.

The interesting thing about Alice is that by the time she was done she was roughly in the 30th percentile--the bottom third of the program. The question is: What happened to Alice? Why did someone who started off so well end up poorly? Well, what happened is very simple. She was somebody who was very good at remembering things and at analyzing things, but she was pretty bad at synthesizing things or coming up with her own ideas. What I want to argue is that the skills Alice lacked are not only needed for success in our program, they are needed for success in almost any kind of real-world life endeavor. What Alice lacked is important for real-world intelligence but something tests in general do not measure. Take any area of science at all, they all have one thing in common; namely, what you actually do with the field test has next to nothing to do with what you do in school in that field. What you do in a typical school course is memorize a text book or solve the problems that are given to you. In our introductory course you are given an introductory psych book and you're expected to remember a lot of the experiments that have been done. If it were a physics course, you'd be given a whole bunch of problems and be asked to solve them. I argue that that has nothing to do with what science is. If you look at the literature on science and the sociology of science, what scientists are evaluated on is not on whether they memorize a text book. If you need a book you get it; you read what you need to read. You do not solve problems that are given to you. If you have a particular problem you can't solve, you get help. The main thing that you are evaluated on as a scientist is the size, the scope, the originality, the importance of the policy you deal with. It's much more important to look at the kinds of problems a person is facing and the creativity they bring to bear in solving those problems than it is to look at their memory and analysis skills. Experiments of not-so-well-known scientists are not so different from those done by more prominent scientists; what differs is the size of the problem or the importance of the problem with which they are dealing. So it turns out that what Alice was good at is not irrelevant to doing well, but it is not nearly as important as the test implies. In fact, what Alice lacked was what was really needed to succeed as a scientist.

What about other fields? Take the humanities; take writing. It is one thing to be told by a teacher in school, "We are all going to write an essay on..." and you go home and write your essay on.... It's another thing when you're actually a writer, whether it's writing articles for newspapers, writing novels, writing poems, or whatever. It's a different thing when you have to come up with your own ideas for what you're going to write about and figure out how you're going to make it interesting. I noticed the biggest difference among the reporters I deal with is whether they know the questions to ask. Their story is going to depend largely on whether they know what to ask me and whether they can synthesize. That's the same thing that matters with a scientist, this knowing how to ask the right

questions. It's also true in art. What distinguishes the more creative artists in the real world from the not-so-creative ones is their ability to deal with sizable and important problems in art.

You could say, these are all specialized occupations--science, writing, and art. So take business. We deal a lot with managers and upper-level executives, and one of the things we hear again and again is complaints about their graduate training. The nature of the complaints are twofold: one is about their interpersonal skills, the other is about coming up with creative ideas for new business products, for new business services, for innovative marketing. Not only do they not know how to do it, but what is worse, they don't know what they don't know. They think they know a lot, and they're not even open to learning what they need to do the job well. So the same problem applies in business. There's nothing wrong with having skills like Alice had, but it is not going to be a substitute for what you really need to succeed in business.

Most of us are concerned with education where the same concept applies. It's one thing to learn how to teach in an education course; it is another to get up in front of a class and figure out what you're going to do. All of us have known of professors who have PhDs in education who were lousy teachers. Somehow they cannot actually apply what they learned in school.

Several years ago I was giving a talk to education professors at the University of Puerto Rico, and for the first time probably in my life, I encountered a serious classroom management problem. They weren't listening; they just didn't care about what I had to say. So I tried the standard classroom management techniques that you learn in school books on classroom management. I tried lowering my voice so that they'd have to lower theirs to hear what I was saying. But the presupposition that they wanted to hear what I had to say turned out to be false. It actually made it easier for them to hear themselves. The second thing I tried is nicely telling them to be quiet so other people in the room could hear. But again I assumed that such a group actually existed. I went through a litany of things and nothing worked, and I realized that when it really comes down to serious classroom management problems, the books don't work. What happened is a woman in the audience stood up, said something in rapid fire Spanish, and after that you could have heard a pin drop. I don't know what she said because she spoke so fast. It was clear that this woman had good creative ideas for classroom management, and it wasn't something she read in a book!

This value of creative thinking applies as well in upper-level jobs. Read Sylvia Scribner's work on milk packers. After starting off doing a standard job, they creatively redefine what they're doing to make themselves much more efficient. It is really quite general. There is even a thesis on horse racing that shows that people use creative and clever strategies in trying to pick winners.

The idea then is that Alice lacks something. What she lacks is not measured by the tests that we use, but it is important for real-world pursuits. It may not be that important in schooling.

The question arises: How did she get to be this way? She is very good at analyzing and remembering but not at synthesizing or creating. One explanation is she was born that way. There may be something to that because there is a genetic component to intelligence, but I want to pose not a genetic explanation but an environmental one. The reason we find that most smart kids are smart like Alice is not because they were born that way but because we made them that way. Alice is basically an outcome of our school system. If we find Alices there in abundance, it's because we have created them. Why is it that when we turn out smart people, we turn them out like Alice? I think the mechanism is a very simple conditioning mechanism. Basically, students in school are rewarded for being like Alice. You get good test scores; teachers like you; you get good grades; you get in the gifted programs; you get into good colleges. Everything goes right in schooling if you are smart like Alice. So people learn the lesson--be smart like Alice. These Alice-like people

move along getting heavily reinforced until they get to this transition point which I have been talking about. What changes is that memory and analytical abilities no longer matter as much. Other abilities start to matter more. The result is that Alice, instead of being continually reinforced for being smart the way she is, starts being intermittently or periodically reinforced. That turns out to be very important to understanding adult intelligence because we know that the kind of reinforcement that most sustains a given pattern of behavior is intermittent reinforcement. And that's what starts happening to Alice. The irony is that when the demands of life change, Alice starts doing even more of what she's been doing instead of capitalizing on her other abilities.

Another example is the book, *Whatever Happened to the Quiz Kids*. Most of these extremely bright kids had IQs over 160 and were on radio or TV shows called "The Quiz Kids." The interesting thing about the book is how boring the adulthoods of these kids were. They were not people you would write about if you were picking them on the basis of their adult accomplishments rather than childhood ones. The question is why? The reason, I think, is simple. If you look at their stories, you see again and again this pattern of overcapitalization on IQ-like abilities and it just stops working. You probably know people like that; they keep trying to use abilities that don't work. If you're very upset about something and you need someone to comfort you, but the one you go to gives you a formal analysis of why you do not have a problem and why you should not be upset, it is not going to help you a whole lot. So, overcapitalization on IQ-like abilities can actually do a person in. Alice may have more creative abilities; she just never finds them.

Barbara-Type Learners

Let me move on to Barbara who has a very different pattern of abilities. When she applied, Barbara's grades were okay, but her test scores were absolutely rotten. At the same time her letters of recommendation were absolutely terrific. You could not have two more disparate sources of information than we had about Barbara--horrible test scores combined with terrific letters written by people we knew and respected. They said, "Don't pay attention to the test scores but look at her work." I decided to look at her experimental work and I thought it was really inciteful, creative, and inventive, and that Barbara ought to be a student in our program. The reason she ought to be a student in our program is because of what I call the fundamental principle of prediction. It is a principle so completely obvious that it tends to be ignored. The fundamental principle of prediction is that the best predictor of behavior in the future is the same kind of behavior in the past. It applies in schooling and it applies in personal relationships. The best predictor of what people are going to do is what they're doing now. The best predictor of what they are going to say is what they say now.

The problem with Barbara is that she probably has not been very heavily reinforced for what she does well. If you look at the difference between Alice and Barbara, Alice was continually reinforced for what she did well and then started being intermittently reinforced. Barbara probably has not been very well reinforced because her test scores are not good. The question is, what's going to happen to her in the future?

I want to say a bit more about intermittent reinforcement because I think it is so important to intelligence in every aspect of life. An example I'd like to give is from work I do on interpersonal relationships. If you are in a personal relationship and it is not working, what do you do? It has been bad for 20 years and you've tried everything. What do you do? As we used to say in the 60's, you decide to dump the person; or as we say in the 80's, you decide to restructure the relationship. Now, because you see yourself as a nice person, you're not mean to the other person. You try to be nice and helpful and you hope that she will get over you. But you notice that after a year or two she is still not over you. The reason she is not over you is because you are intermittently reinforcing her. You are telling her that the relationship is over, yet you are

being nice to her and secretly giving her hope that you'll take her back. You can keep doing this for indefinite amounts of time through intermittent reinforcement. Once it starts, it is really hard to change its effects.

But Barbara has never been very heavily reinforced for what she does. This is a chance to change that. Let's reinforce her for being creative and admit her to our program despite the fact that she has rotten test scores.

So I went into the admissions committee meeting expecting to convince people of this. First, I'm fairly persuasive, and I was supposed to know about testing, and most importantly, I was the director of graduate studies. Barbara's case was discussed at some length. The vote was five to one against her admission. Now the question is: Why didn't Barbara get admitted? She had already shown she could do the work that the program requires. Given that she can do the criteria and behavior, why is she rejected on the basis of an imperfect predictor of the criteria itself? The interesting thing, incidentally, about getting low test scores is that once you have the low quantitative data, everything else looks slightly questionable. Why doesn't Barbara get into psychology or anywhere else either, because she is not going to get into medical school, into law school, into business school, or, basically, into any access routes to adult occupations because they all require the same test or a very slight variance of the same test? Now, there are those who would argue that overuse of tests is just completely irrational. What I want to argue is that actually there are rational reasons why Barbaras don't get in.

The first reason that selection systems work so heavily against Barbaras is what I call the culpability reason. What does that mean? Suppose you admit Alice and she's a bomb; who do you blame? You blame ETS or someone like that. Remember, her test scores were good and her whole appearance on paper was great; if she doesn't work out no one can blame you as an admissions officer. If she doesn't work out it certainly isn't your fault. But suppose Barbara doesn't work out (and some Barbaras won't)? Whose fault is it going to be? The answer is...yours! People are going to say: "You should have known she would be no good; look at those test scores. It's not her fault she didn't do well on the program; she shouldn't have been admitted in the first place." So if you take a Barbara you're taking a risk and the risk is that you, rather than Barbara, will look bad.

The second reason Barbaras don't get in is what I call the resemblance reason. Ask yourself: Who is making the selection and placement decisions? The answer is...Alice, or people like Alice. You know that because, if they're making the decisions, you know they got in. If they got in, their test scores had to have been pretty good. We tend to judge other people by ourselves. Look, I must be pretty good because I'm making the decisions here, and I did okay on these tests. Why take someone like Barbara when there are plenty of Alices to go around. So you take people who are more like yourself and you perpetuate the system.

A third reason that Barbaras don't get in is what you might call the publication reason. It's also a very simple one. Places publish their scores, or if they don't, someone else will. Whether it is Barrons, the American Council on Education, or your own university, somewhere somebody's going to publish these scores. What will happen if you start taking Barbaras? Your program will look bad. A couple of Barbaras can do bad things for your average test scores. People will see the average test scores go down and they will say, "That place is really falling apart; they can't even get good students anymore." This is not just at the college level. In Connecticut, the newspapers publish the statewide mastery test scores and I was appalled when I saw that the district my kids were in does not have very good scores. What am I paying all these taxes for if that's the best that the district can produce? Besides, it's bad for property values. Who's going to want to buy your house if you've got schools that are producing those kinds of test scores?

Probably the reason that is most powerful is what I call the "rain dance reason." This is the way it works. I think these Montana mountains are great, and it's really beautiful

here, and I was actually thinking last night seriously about buying land here. Then I started asking myself when would I ever get back? You know, I'm too busy and, besides, it's expensive to travel to Montana. What I need is a system to keep having my plane fare paid. The problem is you stay here two days and give your talk on intelligence, and by the time you are done they figure: he's told us all he knows; let's get someone else next year. So you realize that if you want to come back you have to do something else, and I doubt if people will hire me to talk about my love life. But I noticed there are some drought problems around here and there are fires. So I say, "Hey, look, what I can do is handle droughts. If you pay for me to come back, I'll make it rain and you won't have to worry about all this fire stuff." So you figure, why not, especially because I say I'll give you double your money back if I can't make it rain. You pay for me to come up and I get up on this very stage and, instead of talking about intelligence, I do a rain dance. Does it rain? Of course not. So you say you want double your money back. But I say, "You must be kidding! You know this is one of the worst droughts we've had. Yellowstone is practically gone. You can't seriously believe that one rain dance is going to be sufficient." So I keep doing the rain dance. It doesn't take that long and I spend the rest of the time enjoying myself. After I've done the rain dance for awhile, it rains. I say, "Thank you very much. It was a great trip. I'm glad I could help out."

A lot of us don't like to admit that we have superstitions, but I think we all have them. What does this have to do with Alice and Barbara? What I want to argue is that testing works the same way in our institutions. Virtually all people who make admission decisions have some score below which they won't admit people. They may not admit that, but they do have a score. Here is the interesting thing. You won't ever see anybody with scores below that who has successfully completed work in their program! So they always get confirmation of what they already believe. The reason is that they never take the people with scores below that point so they never find out if they can do the work. Superstitions are superstitions because you don't disconfirm them. That, I argue, is what happens in schools because we generally don't take the risk to find out if the people can succeed.

One other thing about the use of testing that bothers me. I want to tell you about a personal experience with my son, Seth. Seth was in the second grade where he was in the top reading group. After my wife and I split up, she moved him to another school district which was comparable in socio-economic level in every way. They put him in the bottom reading group. My question is how could he go from the top reading group of one district to the bottom in another district? The answer is very simple; he didn't do well on the reading test. Maybe that's not so surprising. It is conceivable that he might have a little anxiety moving to a new home, a new school district, new friends. Anyway, he did not do well on the reading test so they put him in the bottom group. After a short time, they noticed he was reading better than others in the bottom group. Nothing surprising about that; it was the wrong group. So what did they do? They gave him another test! He performs the criteria behavior fine, so do they move him up to a better reading group? They insist they need the predictor. So they give him a reading test again, and he does better so they move him up to the second group. He is in the second reading group for quite sometime, and they notice he is reading better than the others. So what do they do? They don't say, let's move him to the top reading group; they say, let's give him another reading test. So they give him another reading test and he scores at the level of the first group. What do they do? Keep him where he is. I asked them why they changed their logic. They told me, "Well, it's true that he scored at the level of the top group, but now he is a full book behind the top group. If we move him to the top group, he would miss all that's in that book, so we're leaving him in the second group." So I said, "We'll take the reading book home and work with him on that book." "No, we don't let reading books go home." You sometimes wonder whether tests are self-fulfilling

prophesies.

I don't think it's just tests. When I look back on my school days, I was very test anxious. I did poorly on tests and my teachers had very low expectations for me. I wanted to please the teachers, so I didn't do very well in school; I did exactly what they expected of me. An odd thing happened. I was doing so badly on tests that in 6th grade they sent me back to retake the 5th grade test. At first, that was embarrassing. But it actually was a godsend because I wasn't nervous competing with 5th graders. After that, I was never test anxious again. I started doing better in school so teachers raised their expectations. Because I wanted to please them, I did better in school. Self-fulfilling prophesies are not just an abstraction. It happened to me and it happened to my son.

Let me tell you what happened to Barbara. I figured that someone like Barbara should have a chance to show what she could do, so I hired her as a research associate. She turned out to be terrific. There were good reasons to hire her. People should have a chance to show what they can do. Besides, I was a little bit over 30, and you know what adult educators say. Your fluid ability--how flexibly, how quickly, how easily you think--goes up until about 30 and then it starts to go down. I figured if I was not going to have good ideas, I ought to have people like Barbara around. Anyway, Barbara was admitted to the program the next year, and she has done absolutely well.

Celia-Type Learners

Celia was different from Alice and Barbara. Her grades were good, but not great; her test scores were good, but not great; her transcripts, her letters of recommendation, her extra- curricular activities, everything about her was good, but not great. I figured this was someone we ought to admit. We know she is going to be good, but not great. You have to take people like Celia into your program; you have no option. There have to be people in the program who are good, but not great. Abilities are supposed to be distributed on the normal curve. You have good people like Celia for statistical reasons so you have a distribution. We did, and, sure enough, she turned out to be good, but not great.

The interesting thing about Celia is that when she applied for jobs, despite the fact her performance was good but not great, she really did well on getting job interviews. Everyone wanted to hire her. What was it that Celia was doing that made her very attractive on the job market? The answer is very simple: she can go into an environment, figure out what is needed to move ahead in that environment, and do it. She is like the second boy in the forest story who was very sharp--practically intelligent. In graduate school, she figured out what kinds of research are rewarded, what journals to publish in, how to behave with professors, and so on. And she could implement what was needed to be very successful. My argument is that is very important.

We had a student apply who was very different from Celia. He was both analytically and synthetically brilliant. Some professors said he was going to be very successful as a psychologist, but my reaction was that he was going to be a flop. The reason I disagreed was not that I questioned his academic brilliance or his creativity. He had those, but he was incredibly arrogant. He was smart and he knew it. You might say that that has nothing to do with intelligence, and I would agree that arrogance is a personality trait, but there is intelligence involved here. The guy was not practically smart enough to hide the fact for one day that he was arrogant. To get a job he needed to hide it at the job interview. Sure enough, he goes to lots of interviews, but no one wants to hire him.

Most people accept that Alice-type behavior is intelligence. Some would accept that there's really something to the Barbara- like activity. But most feel that Celia is not intelligent. They believe it is personality or manipulativeness or common sense, but it is not intelligence. I want to make the argument that what Celia has is really intelligence. It is important to realize that what we generally don't think of as intelligence is so important and is really intelligence. We have to look at

people in context to understand how smart they are. If you don't understand the context, you don't understand the intelligence.

In a study Joe Glick did among a tribe called the Kpelle in Liberia, he used a sorting task. He gave them names of fruits, such as apple, orange, and grapefruit; names of vegetables, such as lettuce, broccoli, and celery; names of vehicles, such as rafts, busses, and boats. They had to sort them into piles however they wanted. What he found is that the Kpelles did "dumb" things. The "smart" thing is to sort taxonomically by names of fruits, vegetables, or vehicles. Well, the Kpelles sorted the functional way. They sorted apple with eat or car with gas. Instead of sorting by higher order categories, they sort by what the thing does. That's not only considered stupid by some, it's considered stupid in an IQ test. On the Stanford Benet or the Wechsler Intelligence Test, defining an automobile as a vehicle of conveyance is a two point answer. It's a higher order taxonomic definition. Saying a car is something that goes on a highway or uses gas is a one point definition. Functionals are worth less; they are not considered as smart. Glick was persistent and said, "Try sorting a different way." They sorted a different way, but it was still functional. Finally, about to give up on the experiment, he said to them, "Why don't you sort it the way a fool would"? Guess what? They sorted taxonomically! There is a good reason for this. If you think about apples, what do you think about? You probably think about eating, not about it as a fruit or an organic substance. If you think about a car, you probably think about driving or getting gas. You don't think of it as a vehicle of conveyance. In the everyday world, you usually think about using things. In school, especially when taking tests, that is not the answer you are supposed to give. But the Kpelles are not an IQ tested culture, so what they did on the test is what they do in the everyday world--just as you would. They got it wrong, but you know from your socialization that is not the answer that's expected. If you don't understand the context, you don't understand what people's abilities are.

A second example is from work done by Shirley Heath, an anthropologist who is an expert on the development of languages. I want to argue again that you cannot understand intelligence if you do not understand the environment in which it has been socialized. Intelligence to a large extent is socialized. Parents want their children to be smart so they raise them to be smart. But if what they think is smart does not match with what the school thinks is smart, the kids look dumb. That applies at any level. If what you think is smart on a job does not correspond to what the workers' abilities are, chances are you will say: "They're not very smart. What are they doing in this kind of a job"? Heath found that in the three communities she studied, the socializations were very different. For example, the children from the lower class black community tract, did poorly in school from day one. By the time they finish school, they are doing absolutely terrible, and the jobs they get are the dregs that are available. No one wants to hire them because they look so stupid. Well, one of the things she discovered is that in such tracts, the primary mode of communication is nonverbal. Literally, from the day the kids are born, there is a lot of emphasis on decoding and encoding of nonverbal usage. They are really very sophisticated in nonverbal communication. In contrast, the children that grow up in the middle-class white community become very sophisticated in the primary mode of communication used there, which is verbal, of course. They learn relatively little nonverbal communication. The punch line is that if you take a person from a verbal community and put that child or adult in a tract, that person really looks stupid because they cannot communicate with the people in the tract. But you know what they are going to say: they just cannot communicate because the people in the tract are dumb. The problem is that the school is not indifferent to which of the environments the person comes from. The school emphasizes verbal communication. So then the kids from tracting truly look dumb.

Now the interesting thing is that one could make a good argument that we emphasize in

our society is the importance of nonverbal communication. If anything, we ought to be rewarding what the parents in the tracts are emphasizing. For example take teaching or giving a talk. Think of speakers you have heard or teachers you had in college. Some were very boring! Sometimes I wonder how someone could have been boring for 30 years. Or did you ever hear a talk by someone very senior in the field, but you can't read anything on the transparencies? You know he has been doing that for 30 years. Why do such people make the same mistakes year after year? The answer, I think, is quite simple. No one tells you that you are incredibly boring. It's too risky. The communication you get about being boring or that no one can read the slides is a giggle or laugh or stirrings in the room. The communication is nonverbal. If you are sensitive to that, you have a chance to improve your act. If you don't pick it up, you are going to be doing the same dumb thing for the next 20 years.

A second example, is any kind of interview. If you're not doing well in the interview, chances are the interviewer is not going to tell you, "I want to be honest with you. This is a boring interview." Rather, the signs are nonverbal. When we interview job candidates from California, and they're no good I sometimes feel like saying: "Look, we brought you out on American Airlines and we'll send you back in a Greyhound Bus if you'll just go now." I don't do that, I go through the whole rigamarole and at the end am glad the day is finally over. If the interviewee is sensitive to nonverbal communication, that person at least has a chance of realizing that things are not going well and to change the way he or she is structuring the interview.

A study I did at Yale when I worked in undergraduate admissions was a cost benefit analysis of admissions offices. A main finding was that the interview was essentially worthless in terms of selection. Nevertheless, I argued that we continue the interview. The correlation between how well people do in the interview and how well they think they have done is quite low; they rate themselves higher than others rate them. The result is that people like interviews even though that is based on nonverbal information. Those sensitive to nonverbal communication have a chance of picking up what goes wrong.

Another important example is from interpersonal relationships. Real world intelligence applies as much to relationships as it does to jobs. When things start to go wrong in interpersonal relationships, the communication initially is never verbal. The reason it is never verbal is that when things start to go wrong, you don't know it consciously. Something starts to bother you and you're not sure what it is. At first you don't even know something bothers you, but you start saying nonverbally that things are wrong. There are all kinds of nonverbal cues that something is bothering you, but usually there is nothing verbal. What is even more upsetting is that after you realize there is a problem, the communication is still nonverbal. You know that something is wrong but you cannot quite put your finger on what is bothering you, so you continue to say nothing verbally.

With someone who is sensitive to nonverbal cues, there is a good chance that you can nip the problem in the bud. With someone not sensitive to nonverbal cues, by the time the problem is recognized, it may be too late. The same thing applies on the job. When your boss starts getting unhappy with you, the cues are nonverbal. If you cannot pick them up until the boss tells you something is wrong, you are in trouble.

The argument I have been trying to make is that this matters. Practical intelligence is practical intelligence. It is not trivial; we have to pay attention to it.

Measurement of Intelligence

We measure best the Alice-type intelligence. One can argue, we may not do well with Barbara-like stuff, but at least we do well with Alice-like stuff. What I want to argue is that we do not do that well with Alice-type intelligence either, but that there is tremendous room for improvement. Let me give you some examples of why it is that, even when we measure supposedly well, we do not measure that well.

Start with an important aspect of intelligence which is in the Alice-like part of my theory; that is, the ability to define problems. On a test, if you do not define the problem the way the examiner defines it, you are in trouble. Take an example from my own research. We did a study of analogical reasoning of 2nd, 4th, and 6th graders and adults. We wanted to find out what changes with age. Second graders were the worst, 4th graders were better, 6th graders were better than that, and adults were the best. Basically we showed that people get smarter as they get older. But I realized that a finding so revolutionary would never be accepted by a journal, so I decided to look for something less interesting in the data. I looked at the data and discovered something odd. There were 2nd graders who got none right, absolutely zero. This was odd because we used the two- choice analogies, which means a 50% chance of being right. You need to realize that in test scoring, you never see a zero; what you see is a percentile of 1, a grade equivalent of 3, an IQ of 10. You don't see that there is something really bollixed up. What was wrong in my study was very simple. We gave analogies, A is to B as C is to D, in a Hebrew day school where they had English instruction in the morning and Hebrew in the afternoon. We did the testing in the afternoon and some who got zero circled A or B. Why? They were reading right to left. It was in the afternoon when they would normally be reading in Hebrew so they defined the problems wrong. They may have deserved one point off for not understanding our very clear directions, but they did not deserve zeros.

Sometimes the people who take the tests are smarter than the people who write them. I published an article in *American Scientist* in which I gave an example of what I thought was a very good item. It was an insight type of item called the Water Lily Problem. You have water lilies growing on a lake. At the beginning of the summer, there is one water lily on the lake. The water lilies double in area every 24 hours. At the end of sixty days the lake is completely covered with water lilies. On what day was it half covered? That is an insight problem which you cannot just routinely solve. You have to think about it to realize that the lake was half covered on the 59th day. Because the area doubles every 24 hours, if it was completely covered after 60 days, it was half covered after 59 days. About a month and a half after this problem was in the article, I got a one and a half page, single spaced, typed letter from Paul McCreedy, a famous aerodynamic designer. He proved that if the water lilies really doubled in area every 24 hours, at the end of 60 days, three-quarters of the world would be covered with water lilies. The sad thing is that if he had done that when he took the test, (a) he would have spent all of his time on that one problem, and (b) he would have gotten it wrong. Again, there is a real danger in terms of how people define problems.

Take that second issue of time allocation, another important Alice-like skill. In our culture we associate speed with being smart. If you say a child or an adult is quick, it is another way of saying they are smart. Virtually every standardized, group test of intelligence is timed. Test publishers tell you that you don't have to be real fast to get through them, but I don't believe them. When I took the verbal section of the GRE, I did not finish. I was absolutely shocked because by that time I had worked at ETS and had developed my own intelligence test. I was pretty test-wise, yet here I was not finishing a test. I had about five problems left and I knew I could get a lot of them right if I was given the time. That leaves two options; one is to get those problems wrong and the other is to cheat. When you get the math section done, you go back to the verbal section and finish the verbal problems--which is cheating. I am not going to tell you what I did, but I will tell you I did very well on the verbal GRE.

We did a study of lay people's conceptions of intelligence in which we asked people in a supermarket, a train station, and a library what they thought it meant to be smart. They said things like, "thinks quickly," "reads quickly," "talks quickly," and "writes quickly." Quickness was very important. Our granting agency did not like that study; they said people in a

supermarket don't know anything. They said we should ask experts in the field of intelligence. So we wrote the experts and got responses like "thinks quickly," "reads quickly," "talks quickly," and "writes quickly." It is clear that it is not always that fast is smart. Obviously, you want an air traffic controller to be fast. You don't want people who ponder the deep meaning of two planes coming at each other. If you are taking a test, you want to be fast. But there are times when it is not very smart. For example, most of us could think of some important decision we made in our lives and were wrong because we made it too fast. We make decisions that are not good because we make them too fast. That's not to say that it is always smart to be slow. Thurstone actually wrote that to be smart is to be able to withhold instinctive responses. The smart person can withhold action, think about it, and then decide the smart way to react. All I am arguing is that the smart person knows when to be fast and when to be slow.

Our research shows that if you look at people's planning behavior, for example, smart people are not always faster than dumb people. Smart people actually spend more time on what is called global planning; that is, they spend more time deciding what to do and less time planning the way to do it. People who are not so smart spend less time on global planning. The price they pay is that it takes them longer to do the task because they have to double back; they get on false trails.

The way tests measure reading comprehension is ecologically ridiculous. You could never do in your everyday life what you do on a reading comprehension test. To do well you have to read everything with a fine-tooth comb because of the detail questions. If you read everything with a fine-tooth comb in your everyday life, you would never get anything read. You have allocate your time so that you read some things carefully and skim others. Again, the smart thing in everyday life does not pay off on tests.

Let me move now to Barbara-like intelligence. If you look at an emerald ring, most people will agree that emeralds are green. If it happened to be a sapphire ring, most would agree that sapphires are blue. What I want to argue is that it is not clear that the emeralds are green or that sapphires are blue. If you want to assess Barbara-like intelligence, suggest to someone that it is possible that emeralds are actually grue, meaning green until the year 2000 and blue thereafter, whereas sapphires are actually bleen, meaning blue until the year 2000 and green thereafter. If you think about it, the evidence is no better than emeralds are green than that they are grue, because you don't know what's going to happen in the year 2000. Now you could say that emeralds are green this year, and they were green last year, and they were green the year before. But they were grue every year too. The only year in question is what happens in the year 2000. We don't know. You could argue that: Why would anyone want a complicated concept like grue, which involves a switch from green to blue in the year 2000, when you could have a simple concept like green? What I would argue is that it is not clear that grue is not a more complicated concept than green. Why? Suppose you were brought up to believe that emeralds are grue and sapphires are bleen. Then you go to some crazy place where they tell you that emeralds are actually green and sapphires are actually blue. Why would you want a complicated concept like green which involves a switch from grue to bleen when you can have a simple concept like grue where the thing is always grue? What is more complicated depends on where you start.

For our testing purposes, we were interested in a person's ability to think with novel kinds of concepts like grue and bleen or, in another scenario, on the planet Kirod, there are four kinds of people. Plens, who are born young and die young; Quests, who are born old and die old; Balts, who are born young and die old; and Pothens who are born old and die young. What you have to do is reason with concepts that are not only different from those you know, but different in kind. What we found is that Barbara excels Alice in her ability to transit between green/blue thinking on the one hand, and grue/bleen thinking on

the other, and back again. She is comfortable making switches that Alice is not comfortable making.

On the Sternberg Multiconventional Abilities Test, a test I am working on with Psychological Corporation, we give people verbal analogies, but the words are simple. It is not a vocabulary test, but there is one little trick--analogy is preceded with a premise. Half the time the premise is ordinary, but half the time it is a statement like "sparrows play hop scotch" or "villains are lovable." It is a counterfactual presupposition and you have to assume the presupposition is true to solve the analogy. It is interesting that Alice will do better than Barbara on a standard verbal analogy, but Barbara will do better than Alice if you say "imagine" that the world is this way rather than the way it is. This is an important ability for Barbara-like thinking because what we were talking about before was business people, scientists, artists, writers, and educators who all had in common the Barbara-like ability to see things in a way that other people do not see them. This is the ability to look at an old problem in a new way or a new problem in an old way, but to see it from a perspective that just does not presuppose what everyone else presupposes.

There is a danger in Barbara-like ability. A lot of research has been done in the last 10 years on expertise, and what it shows is that experts know more than novices and they structure their knowledge better. What has interested me for a number of years, and what we are now researching, is what I call the cost of expertise; that is, ways in which experts become worse than novices. I have argued that the danger of expertise is that they start to know too much. The advantage I have over my graduate students, being older and more educated, is that I have all kinds of proceduralized routines. Things that for me are automatic, for them are hard. To me, some things are proceduralized. If you look at it from their position, they have an advantage that I don't have. Novices are more flexible than experts because they don't have as many of the proceduralized routines. The novice has the advantage of seeing new perspectives that the expert starts to lose.

We have done research, using the game of bridge, where we showed the loss of expertise. If you give experts and novices bridge games, the experts will do better. If you change the surface structure of the game, for example, change the name of the suits or their order, it does not hurt the experts. They have things so proceduralized that they automatically make the changes. The novices are hurt by that. But if you change the deep structure of the game, say, the person with the lowest card starts the next round instead of the person with the highest card, the novices aren't hurt any more by that than by the surface changes. But, changing the deep structure seriously hurts the experts' ability to play the game. In other words, the cost of expertise is that you become so good at what you do that you can't see another way to do it. You lose whatever Barbara-like ability you once may have had. We need to build resources into our lives so that we do not lose that kind of flexibility.

Finally, I want to talk about Celia-type intelligence. Basically, to understand intelligence you have to understand a person's ability to adapt to context. If you are interested in practical intelligence in adulthood, you already know that. The question is, can we measure it? It is one thing to say that intelligence has adaptations, and another thing to measure it. Rick Wagner and I decided to try to measure it, and the way we started was to interview people who had been nominated as practically intelligent in two occupations, business executives and college professors. We asked them, "What does it take to be practically intelligent in your field?"

They agreed on three things. One, IQ does not matter much. That did not surprise us because we already knew that the correlation of IQ with life measures of success is about .20.

The second thing they agreed on was more embarrassing. What you learn in graduate school or professional school doesn't matter very much. I thought about it and realized that I learned in school nothing of what I needed to succeed on my job. For example, to be practically intelligent as a faculty member

you have to learn how to write a grant. If you don't get a grant, you don't get any paper clips or any paper, and none of the students want to work with you because you don't have any money. Eventually you lose your job because you did not get any research done. The interesting thing is that they did not hire you to write grant proposals. There was nothing in your contract or in your job interview that said this was important, but, if you don't know how to do it, you're out of a job. Another thing is how do you get a big office? Some people have big offices, some people have small offices. They never tell you that in graduate school. I noticed that the people with big offices tended to be people who got along better with the chairman. They don't teach you how to do that either. It could go on and on. If you think about what you need to succeed on the job, probably only a small fraction of it is what learned in graduate school. It's not that what is taught in school is wrong, it is just not relevant. The valuable ideas you get out of graduate or professional school is not what you learned in courses, it is what we call passive knowledge.

That is the third thing all agreed on; it is passive knowledge that really counts. What Celia is so good at is the ability to go into an environment, pick up what you need to adapt to that environment, and then do it. That is what you get out of graduate school, watching people who are role models and internalizing the way they do it. Passive knowledge is not even verbalized, much less taught.

We constructed tests of passive knowledge and decided what you need on a test of passive knowledge is exactly what this whole talk has been about--the ability to allocate resources. Earlier I talked about allocating resources in academic settings; the same thing applies in everyday settings. The test gave people this type of problem. You're in the second year on the job. Here are some things you need to get done in the next two months; you do not have time to do them all. What are your priorities? Or, you are a senior executive, or senior college professor, giving advice to a junior person in your field. Here are some pieces of advice about what leads to greater or lesser success in your company or university. Weight the quality of the advice.

What we found from the passive knowledge tests was, on the average, people who have been in the field longer have more passive knowledge. No surprise there. But what is more interesting is that some people with much experience have poor passive knowledge and some people with little experience have very good passive knowledge. It is not actually the experience that matters; it is what you learn from the experience.

I see job advertisements that require x number years of experience. I think they are silly because there are people in the field for 30 years who are still boring lecturers, who still do not know how to do their jobs or how to get along with people. It is what you learn from the experience that really matters for practical intelligence.

You may ask, is a passive knowledge test just a fancy IQ test? Does it have the same concepts as an IQ test but with a little window dressing to make it more content or face valid? The answer is no; the correlation of passive knowledge with IQ is not significant. We are not just measuring the same concept in a fancy way.

A third finding is that passive knowledge scores predict worldwide criteria twice as well as do IQ tests. The correlation is about point .40 rather than .20. We can actually predict fairly well how well people will do on their jobs. We have done it now with college professors, salesmen, waitresses, businessmen and with college students. Much of what you need to succeed in school is not what IQ tests measure, but passive knowledge. What does the teacher expect in the writing of a paper? How do you study for an exam? How do you study in math versus how do you study in social studies? One of the mistakes I made was trying to read a calculus book like I read a novel. When I got to the exam I had no idea where the questions came from. What we have found in our research is that passive knowledge predicts college grades as well as an SAT-type test does. It really counts in college as well as in later life.

Passive knowledge is critical to your

ability to adapt, but the ability to adapt is not all there is to practical intelligence. Sometimes it is not smart to adapt. If you were told you were going to work for a research-oriented institution and you end up teaching five courses a semester and being on six committees, it probably is not the job for someone who really wants research. If you are in a relationship and it is absolutely not working, the smart thing is not to adapt. If you go to work for a computer software company because you're interested in developing educational software, and you end up in the industrial espionage division, the smart thing is not to adapt. There are many times when the smart thing is to select another environment. Part of being smart is knowing when to quit. There are some jobs you might like to leave but can't. There are some relationships you don't like but, for one reason or another, cannot leave.

That leads to the third and important option, shaping. Practically intelligent persons not only know how to adapt to environments, or how to select them, but sometimes shape the environment to suit them. Lee Iacocca did not go to Chrysler thinking what does it take to be a good Chrysler person? He defined it! People who are great in art, music, science, business, and education do not just adapt to the existing environment; they create environments for themselves and for others.

What shapers have in common is not what IQ tests measure. One of the things we have found they all have in common is that they're good at some things but not at others. In fact, there are a lot of things they're not good at. One of my surprises in graduate school was to find famous professors who were bad at many things. It is not what they have in common; it is that they are really good at something. It may be just one thing, it may be two things or three, but there are some things they are really good at and there are lots of things they are bad at. Here are the critical things: they know what they know what they are good at; they know what they are bad at; and most importantly, they capitalize on whatever it is that they're good at. They make the most of it and use it effectively in their lives, in their careers, and in their personal relationships. They exploit to the fullest what they do well. They compensate for things they don't do well. They either find other people to do these things, or they make it unimportant in their work, or they make themselves just good enough so they can get by.

If you want to understand intelligence, do not look just at a static set of abilities. Look at a person's abilities to capitalize on strengths and compensate for weaknesses. Most of all, understand not only Alice-like intelligence, but Barbara-like and Celia-like intelligence too.

Strategies and Learning

Claire E. Weinstein

When I was a graduate student studying educational and experimental psychology in the early 70s, many researchers were still focusing on the learning of nonsense syllables, consonant/vowel/consonant letter strings. Much of the new and exciting research was examining the learning of words. I am glad to report to those of you who might be interested that we've gotten to the level of sentences and paragraphs, and hopefully we will get to whole pages pretty soon! But these were the types of things that we studied when I was a student, and I brought a sample word list with me. Please take out a piece of paper. I have a list of 12 words and what I want to do is read these words to you at the rate of one word every three seconds. Your task is to remember as many of these 12 words as you can. You do not have to worry about remembering the words in order. This is what is called a free recall task, not a serial recall task. All you have to do is try to remember as many of the 12 words as you can. I am going to read the words to you now, but please do not write anything at this time. After I have read all of the words, we will wait for 20 seconds and then I will ask you to write down as many of the words as you can recall. Again, do not worry about word order; do not worry about guessing. Okay, let's begin. Bed, rest, tired, night, pillow, yawn, cover, dream, sheet, pajamas, slumber, alarm. Do not write anything for 20 seconds. [Idle chatter for 20 seconds.] Now write as many of the words as you can recall; do not worry about word order; do not worry about guessing. [Short pause.] Okay, what I would like to do is go back over the list and I would like you to raise your hand to let me know if you remembered the word. How many of you got "bed"? Sharp group! How many of you got "rest"? This is good. How many of you got "tired"? How many of you got "sleep"? Put all of your hands down; the word "sleep" appears nowhere on this word list!

This list was developed by Ken Higby at the University of Utah. The word sleep appears nowhere on the list, but I used this list to make a point more dramatically than I can make if I just say it; that we are active information processors. People are not just passive receptacles of incoming information, whether it's from the outside world or whether it is from our own thought processes. We actively process information; we actively generate our own learning; we actively transform the information that comes to us. Some of you who came up with the word sleep will realize that you used it to help organize all the actions, concepts, and objects that were represented on the list. Others will not even be aware you did it. In fact, I used this once and had a fellow from the audience come up to me at the break and say, "Look, I know you think you didn't say it this time, but you did." We had a recording and we had to play it for him; he was that certain he heard it.

The fact that some people process information more effectively than others has lead to a lot of research. What are some of the differences between more and less successful learners? Bob Sternberg spent a lot of time this morning talking about practical aspects of intelligence and there's a lot of interest now in what we call practical aspects of learning or learning for real-world tasks. However, in this talk I am going to concentrate more on academic learning tasks. My particular interest is young people and adults returning to some sort of postsecondary setting, whether it is a training setting, a formal community college setting, or a college or university setting. Since we have discovered that there are some consistent differences between more and less successful learners that can be changed, we can do something to help students learn how to learn more effectively. For many years learning-to-learn phenomena were treated as part of developmental psychology, not the psychology of learning. This meant that people regarded this primarily as something that evolved; that is, that as you grew older

you learned more about how to learn and so this was part of normal development. Therefore, if you didn't know all that you needed to about learning-to-learn, you just were not intelligent. Basically it was your problem as an individual. We now know that many aspects of learning-to-learn strategies and skills are acquired. Now clearly there are some of us that are sharper than others. However, most of us are not in imminent danger of using all the abilities that we have!

Today I will present a brief overview of the kinds of learning strategies that we have identified that differentiate between more and less successful learners. I will also give a brief introduction to an instrument that we use in our learning-to-learn course at the University of Texas that helps to give some preassessment of where students are in this area. This data provides some information about individual student deficiencies and where teachers should concentrate their efforts.

One of the problems in discussing learning-to-learn is that students' learning and study strategies should form an integrated system. Part of the problem in the past was that many techniques that came out of the study-skills area were presented like a bag of tricks, a collection of techniques without much guidance in how to use them or adopt them to individual needs and contents. That does not work. You need heuristics, you need guidelines, you need approaches, just as you need problem-solving strategies. You cannot teach people how to solve every problem they will face in life. So we teach approaches, strategies, and guidelines so that when people meet a particular instance of a problem, they have an idea of how to come up with a solution that is more optimal, or more efficient, or more effective by some criteria other than one based on simple trial and error.

A system is difficult to talk about because a system is greater than the sum of the parts. It's the old Gestalt idea: the whole is greater than the sum of its parts. So what we need to do is artificially break the system down and then put it back together again. Here are four categories of learning strategies to consider as part of a studying/learning system: (a) comprehension monitoring, (b) knowledge acquisition, (c) active study skills, and (d) support strategies. I will explain them briefly and then give more detail about each one.

Comprehension monitoring is the executive control function in a lot of learning-to-learn and comprehension areas. This implies knowing when you know, knowing when you don't know, and knowing what to do about it. How do you monitor your comprehension or your understanding? One common example is what happens when you are reading along in a book or magazine, and all of sudden you realize your mind has wandered. Your eyes kept going, but your mind wandered. When you realize that has occurred, you go back and find the place where your attention wandered and reread the rest of the material. That is monitoring your understanding. Something triggered you that you were not understanding what you were reading, so you monitored your understanding, realized there was a problem, and went back. This is comprehension monitoring, the executive control function.

Next are knowledge acquisition strategies or the "how" of learning. To learn you need to build relationships between what you already know and what you are trying to learn. How do you do that? How do you build these bridges? We now know that there are different methods that effective learners use to help make sense out of what they are trying to learn--whether it is listening in class, reading a text, or watching a film. A common example of this is the use of analogies. I once had a junior high school Biology teacher say, "I have some students in my class who understand the difference between the arteries and veins and how the circulatory system works, but a couple of my students, no matter what I do, can't get the idea straight. Could you help?" So I took one young fellow and we started talking. I made up analogies like they were going out of style! I talked about thin "vain" people, thick arteries, and the heart working so hard. Nothing. All the kid learned was that it was extremely important to me that he learn the difference between the arteries and veins! He tried as hard as he

could but nothing worked. On the way back to the classroom, I was chatting with him and asked what his dad did. He said, "My father's a contract plumber." We went back to my office and we didn't say anything about the arteries, veins, or the heart. We talked about dirty water, we talked about clean water, we talked about cold water pipes, we talked about hot water pipes, we talked about water pumps. In moments this young man had the whole idea of the circulatory system and how it worked because he had found some way of relating what he knew a great deal about to something he did not understand.

The next category is active study skills. For years, study skills have been kind of the folk medicine of the learning area. There was a lot of truth in there, but like many folk remedies there was also a lot of nonsense as well. What is being researched now is what is useful in study skills and what is not. Many study skill ideas were developed during a time in psychology when behaviorism was of primary importance. Now that cognitive psychology has gained so much advocacy, we are really looking more at what role the learner plays in the teaching/learning act. This does not take away the importance of the teacher or of good learning materials, but it does mean that instead of looking at learners as an outcome variable, we also look at them as part of the input. They are not simply the result of what goes on in teaching and learning but rather part of the process.

The second aspect of the active study-skills category is the active part. Concepts from cognitive psychology and from information processing are being incorporated into study skills. For example, when I was in high school, I learned about outlining while reading James Joyce. The instructor said, "I want you to go home tonight and create an outline. Put the main idea first then important sub ideas under it. You can letter them if you want to. The second main idea goes next and so on." I doubt she talked for five minutes. I had a lot of trouble doing this assignment. I didn't know what the main idea of James Joyce was and I still don't! I couldn't figure out what I was supposed to do. Today, when we talk main ideas we talk about things that are so simple nobody will miss it. People can concentrate on the process. We go through a lot of instruction on how you find main ideas, then we talk about the kinds of knowledge that exist. How are different kinds of knowledge related? We talk about cause-effect relationships, about part-whole relationships, about definitions, principles, examples, and so forth. Then we will talk about different ways you might depict relationships among knowledge. Some of them are hierarchial; some of them can be depicted in trees, some in branch diagrams, some in cause-effect kinds of charts. Then we talk about how all of this can be put together to create different kinds of outlines. Some will make sense for your skills, for the kind of learning you are doing, and for the nature of the content material. All of that is done in the context of the student's goals for doing it. The task requirement will affect what kind of main ideas and information will be pulled out. You can't read text materials as if every line was as important as every other line, but that's what a lot of students try to do. They don't know how to pick out important information because they don't understand what reading comprehension is. Active study skills means putting more active information processing constructs into study skills.

The last category is support strategies. This is an interesting area. Support strategies help to generate and maintain climates for learning. Support strategies deal with what are often called affective variables, variables such as motivation, attention, concentration. There are two different categories: external support strategies and internal support strategies.

External support strategies include such things as having proper lighting or having the papers and books you need for class. I can't believe the number of times I have talked to instructors who give out a diagram in a biology or mechanics class, and the students come the next period and never think to bring it with them. We used to ignore external support strategies in our learning-to-learn course at the University of Texas. We don't anymore. We have had so many experiences like this

fellow who walked in the door and stormed around in my office saying, "This course is such a waste. I'm in a fraternity, and it's so noisy there even you couldn't study!" And he went on and on. I was sitting there getting pretty miffed, so I stood up to my full 5'2" and just said, "Sit down!" And I immediately followed up, "Haven't you ever thought of leaving that fraternity house and just going over to the library to study?" That was nothing but my way of just getting things turned around. But this fellow looked up and said, "Wow! Thanks Dr. Weinstein," and left. Never had it dawned on him to leave a place that was too noisy and go somewhere else to study!

We no longer ignore external support strategies in our course. We have enough evidence to indicate that it is important. We don't spend a lot of time on it, but we do point out the benefits of having light, books, a quiet place to study, a corner of the table to work on, etc.

Internal support strategies relate to the way that we help to create and to maintain internal climates for learning. Internal support strategies include things like being able to focus attention, helping to generate motivation and interest, diligence, time management, dealing with anxiety--all of those things that help us to learn more effectively by creating the climate in which learning can take place. Let me give you an example of this. We do a tremendous amount of assessment of the students who come into our learning-to-learn course, and we have approximately 36 sections a year. So we have about 1,000 students who take our course in sections of 25 every year. Over the years we've discovered that we have several different groups of highly anxious students, but there are two types that are of interest here. If we teach one group about learning strategies and study skills, they are no longer highly anxious. They do not know how to study; when they find out effective ways of doing this, their anxiety lowers. Another group that we encounter knows a tremendous amount about how to use learning strategies, but they are so anxious when studying for a test, preparing for an oral presentation, or something of that nature, that they panic. They are so worried about their performance that they do not use the things that they know how to use. These are some of the ways that we can look at support strategies--controlling those things that may inhibit our ability either to learn material or to perform when we are asked to demonstrate the knowledge and skills we have acquired.

Concentration is another example. For many years we tried to find out what concentration was. I can remember as a child hearing everybody say: "Concentrate harder!" as though it was something you just did. The problem is that concentration is as much a resultant of the things we do as a resultant of things that we don't do. For example, to help yourself concentrate you use things to help focus your attention. Forms of elaboration, such as creating analogies, are major ways of using what we already know to add to what we are trying to learn. That keeps you actively involved in what you are doing so it helps to focus your attention on the task at hand. For example, comprehension monitoring helps focus concentration.

Examples of things you do not want to do are often related to anxiety. Many students who are intelligent and who have the needed skills often end up having less time to take a class exam or other test because of their anxiety. It is not that they don't know how to answer the test questions; it is that they are so worried about their performance that worry interferes with their ability to perform. They spend a large part of the test time worrying about how they are going to do on it and less of their time taking the test. That is what I mean by saying concentration is a resultant of things we do and a resultant of the things we do not do.

Now I would like to cycle back and spend a little more time on two of these areas. The first area is comprehension monitoring. As I said, comprehension monitoring is a kind of executive control function; that is, knowing when you know, knowing when you don't know, and knowing what to do about it.

To monitor your comprehension you need certain kinds of knowledge. One is knowledge of yourself as a learner. For example, what

are your learning preferences, what subjects do you like, what are your best times of day for studying? Knowing about our preferences, knowing which kinds of tasks are easier or harder, helps us allocate resources; it helps us allocate time; it helps us know when we need help. It helps you know that if you have a subject that you are not good at or do not like, you might want to participate in tutoring sessions, go to group reviews, or schedule regular meetings with a tutor or teaching assistant. So, knowing about your strengths, your weaknesses, your preferences, your better times of day, helps you to allocate resources including yourself.

Another kind of knowledge needed is knowledge of tasks. If you don't know what a task requires, then how can you determine if you completed it successfully? It is very important for us as teachers to communicate what we want students to do, whether it is homework assignments or other things, but it is also necessary for us to help students to understand what different tasks require. By different tasks, I mean tasks like reading or listening, participating in class, or different kinds of learning tasks such as discrimination learning, concept learning, and principle learning. They all require different ways of determining whether the task has been met or not. Bob Sternberg pointed out one of these problems for text reading. If you read your textbooks at the detail level you will never get through them. Yet many students read a textbook cover to cover; but worse, they treat every single line as if it were just as important as every other. We have interviewed students at colleges and found people who were working very hard, studying six hours a day, but not doing it effectively. In Adult Education this is a particular problem. Many students entering postsecondary settings had their last experience with formal education 10 or 15 years ago in high school. High school teaching is very different from college teaching. It is much more teacher directed. In our learning-to-learn course it is not unusual for us to get young people who were valedictorians or salutatorians in their high school class, but who are now, a year or two later, experiencing incredible difficulty in college. What was appropriate for high performance in high school and what was expected in terms of taking responsibility for one's own learning is very different in college.

The third type of knowledge needed for comprehension monitoring is knowledge of strategies. Strategies include things from all these different categories. What are the different kinds of skills that I can use to help myself? What do I know about learning-to-learn? What do I know about comprehension monitoring and knowledge acquisition? What kinds of study skills or support strategies can I use to generate climates in which I will more likely accomplish the task? Finally, content or prior knowledge in the area I am about to study will also help me understand what I am doing. There are two reasons why prior knowledge is so important. In academic or professional situations there are two major things that differentiate experts from novices. One is fairly obvious; experts know more. But research in expert/novice differences has also shown that a major difference between experts and novices is not just in the amount of knowledge that they have; it is also how that knowledge is organized. When facing a learning task, prior knowledge can help as sort of a knowledge acquisition strategy. Recalling what you already know about an area often helps you make sense out of something new. Prior knowledge can help make what you are trying to learn meaningful and not just an isolated piece of information.

The second benefit relates to storage and to later use. An example to make this point clearer is the way two people use filing cabinets. Both take new information, put it in a folder, label the folder, and put it in the cabinet. One just keeps adding things to the file; the other tries to put related information together. As time goes on, it is easy to see who will have the easier time retrieving information--the one with the organized files. That is what research points out about organized memory. One of the ways to do that is to consider other knowledge you have about an area as you study something new. You are more likely to store that information with hooks

leading to the other knowledge and thus have more ways of getting to it. That is the second reason why prior knowledge is helpful.

One of the things we do with all these different kinds of knowledge is use them to help monitor our comprehension. The basic way we do this monitoring is through some form of self-assessment. We assess our own learning to determine if it is being successful or not. A problem that can arise for students is something referred to as secondary ignorance--you don't know that you don't know! Many times students have the illusion of knowing. They say, "I really understand how that works, but I can't put it into words." You may have a sense that you know it, but rarely do you really understand something if you can't communicate it. One form of self-assessment is through the use of questions. For a long time the only approach we recommended to students was to come up with questions to guide reading. In fact, in a lot of the textbooks being created today, the summaries and the review questions are put at the beginning of the chapter rather than at the end. The reason is because we know questions help to create goals to guide reading and to use for comprehension monitoring. You can check to see if you understand as you go along. Today we realize there are also other ways to monitor comprehension. One way to do this is through the use of application. Try to apply a new concept or principle. If you have trouble applying it, you get some sense of the degree to which you understand it.

Practice, or actually trying to perform the task that you need to do, and seeing where you make mistakes also provides feedback for comprehension monitoring. Another way is creative organization or transformation. Try to transform the knowledge into another form. The earliest levels of understanding are often considered to be reflected by a student's ability to summarize and paraphrase. If you can summarize and paraphrase, that's the first level of comprehension. One can repeat something verbatim as long as they have enough memory capacity to hold it. It is like the little kid who comes and tells you a dirty joke. You look at the child and know he has no idea what he is talking about. As soon as a learner starts at the level of transformation, organization, doing something with knowledge, then he has shown some level of understanding.

Communicating information to someone else also might help you educate your own understanding. When I want to learn a new area, I propose teaching a course in it. It is one of the ways I learn best. Never have I found where the holes in my knowledge exist more quickly than when I've tried to teach something that I didn't fully understand. In fact, one of the most cost-effective strategies that a lot of people are using now is something called cooperative learning. With adults, cooperative learning involves taking advantage of the best of peer tutoring. Research shows that in terms of learning-to-learn, the person doing the tutoring learns far more than the person who is being tutored. The person doing the tutoring learns about learning-to-learn as well as helping to consolidate his or her knowledge and integrate it across areas. The people being tutored are learning information, but they remain dependent on the tutor or someone else to give it to them. They are not really learning how to learn it for themselves.

Cooperative learning takes advantage of the best aspects of tutoring. For example, let's say that you and I are a cooperative learning pair. We're in a class together and after we go to a lecture I go through the first page of lecture notes and say here is what I think Dr. Smith was saying this morning. Here is the first main point that was made and here is the second. And you say, "No, I think that was an example he used. I think his second point was this because...." Notice we begin talking about what we did and how we learned this as well as getting content transmitted. When we move on to the next page of notes, we switch roles. Now you are the reciter and I am the critiquer. In this way, both students get the benefit of participating in the process. Who's the tutor, who's being tutored? Both monitor each other. Both get a chance to improve content knowledge at the same time that they also increase their knowledge about learning-

to-learn. So it is an incredibly effective strategy and one that is cost effective. It doesn't cost anything but a bit of time. I used this in one of my courses at UT. We created what we call "study buddies." Others have implemented it for the first 15 minutes of class, where pairs go through the textbook or other exercises together. It is a very potent technique. The only warning I would give is that you need to demonstrate this process for people because students are not used to doing this. You can check up on the pairs after you make them, looking for personality conflicts or other things. But aside from monitoring such things, it is a very easy process to get going. It is a takeoff on what they used to do in professional schools and what some students have been doing on their own for years. Another word of caution though is to be careful of who pairs up with whom. If you let students do it, often you will find your D and F students love working together because they reinforce each other's mistakes. So you need to be a bit careful how pairs are formed.

A final point in this area is that research has shown that it is not as critical *how* you monitor as it is *that* you monitor. This is a very important point and it relates to knowledge acquisition strategies as well. The fact that you monitor your comprehension has a critical impact on how successful you are; the particular method you use does not. In fact, for the same task, many different methods are used by different students. Even for what appear to be highly similar tasks, different methods are used by the same student. There are many things that can determine how we monitor comprehension.

For example, things like the nature of the assignment or fatigue affect it. The critical point is that students need to have a repertoire of different ways that they can monitor learning. Those things that work for us day in and day out as we do our learning activities are fine, but we need other techniques when we run into problems.

This also relates to something we call fluency and flexibility of thought. In terms of problem solving, fluency can be described as the number of solutions or the number of alternatives in the decision process that a learner comes up with. Flexibility is the number of categories into which these alternatives fit.

As an example, we can go back again to the experience of reading along and discovering that your eyes have kept moving but your mind has not. Earlier I asked you what you would do, and you said you would go back over the material. What else could you do if you realized your attention wandered? Fluency and flexibility of thought might lead you to suggest taking a break, getting a drink, making a phone call, or settling the argument that is percolating in your mind. You might go over the summary or review the introduction. Phoning somebody else in the class might help; so might using another source. You could wait to ask the instructor about it the next day or you could call someone in your study group. There's a number of different things that could be done. The number of things you come up with is a measure of your fluency. Flexibility would be the number of different categories. Suppose a person came up with five different things they could do such as take a break, go get a sandwich, go to the bathroom, take a walk, call up a friend. They have five actions but all are in one category--take a break. They would have a high fluency score but very low flexibility score. Someone else might suggest five things but one might be take a break, one call a friend in the class, another reread the material, another get another source. Notice that this person would have the same fluency score but a very different flexibility score.

Effective comprehension monitoring requires both a degree of fluency and of flexibility. However, many students in postsecondary educational settings do not evidence a great deal of fluency or flexibility in their thinking or the learning strategies that they use. When you interview them about the things they do in typical academic situations, often they can think of only one thing to do. When you get to two possibilities you've now eliminated almost all of the students you deal with. Three is such a small minority that you're thrilled when you find someone in this

group! It is very important to help students develop a repertoire of strategies so that they have some fluency in what they can resort to when they run into an academic problem, and so that they have some flexibility so if the type of solution or approach that they choose doesn't work, they can find another.

A final aspect of comprehension monitoring is what is called fix-up strategies. Fix-up strategies are what one does to fix comprehension problems. Fluency and flexibility of thought are most critical in discovering what can be done to solve a problem. You all laughed at the example I gave of the young man who was upset with our course because his fraternity was so noisy no one could expect him to study there. He never thought of leaving to study someplace else. Unfortunately, this is a common problem; students need to be more fluent and flexible in their thinking and learning processes.

The second major area of learning strategies I want to discuss a bit more is internal support strategies. For a long time we have had good ideas about some of the things that students report as debilitating to school performance. One of the most common things that decrease the effectiveness of their performance is anxiety. It is difficult to find a student who does not report that at some time debilitating anxiety has severely affected his or her performance in some academic situation. In fact, today the hottest research area in anxiety is with elementary school children. By second grade students often show trait anxiety as a problem. When I was in graduate school I had a friend who had a little boy named David who was very beguiling. He was three years old and the love of David's life was preschool. He was so crazy about it that if he woke up at four in the morning, he would put on his clothes and get ready for school. Then one morning David did not want to go to preschool. In fact, he was hiding in the closet. They had to dress him; they had to take him by car to preschool; they had to physically hand him to the teacher. Nobody could figure out what was going on. That night we found out what had happened; David came home with a note pinned to him. David wasn't sure what he had done wrong but the message had very clearly been communicated to him that there was a problem. David had flunked threes; he didn't do very well in twos either. David did not want to go back to the preschool.

The experience of debilitating anxiety is so ubiquitous and so personal that we have developed a number of interventions to help reduce it. When I was a graduate student, there were dozens of studies trying to help people with their anxiety and to improve their study skills and their performance. The interesting thing was that many of these studies used relaxation therapy. In its simplest form relaxation involves going through the body systematically, starting at one end. You tense each muscle group and then relax it. The idea is that you need to be aware of tension in your muscles and you need to learn when they feel calm so that you can then reproduce this calmness. It is an extremely effective technique for many health problems. It is very important to learn techniques that help you to stay calm. However, from a cognitive standpoint and in terms of academic performance, it did not have much impact. The students were calmer, but they were still flunking! We were not able to explain anxiety until Jerri Wine came up with something called a cognitive attentional view of anxiety. It is cognitive because it focuses on our own thought processes and it is attentional because her explanatory mechanism is in the area of attention. The relationship between anxiety and performance is a curvilinear relationship. Most people do fine at a mid-level of arousal. They are at the optimal level for motivation, for paying attention. However, for many people performance is seriously affected as anxiety continues to increase.

Now we know there are two dimensions to anxiety. One dimension is emotionality--butterflies in the stomach, hives, tick in the eye, buckling knees, sweaty palms, all of these different things. People experience different things emotionally in response to anxious states.

The other part of anxiety is worry, sometimes called cognitive worry. This is the major

culprit from the perspective of academic learning and performance. Worry is often manifested in something we call negative self-talk which feeds on itself. "I'm no good; I can't do it; why am I here?" All of this negative self-talk feeds on something called irrational beliefs such as, "The rest of my life depends upon this one task." There's an excellent book in this area for those interested. It is directed to the intelligent layman and is put out by Monarch Press, *Stress, Sanity and Survival*, by Rob Woolfolk and Frank Richardson.

Let me give you an example of how anxiety debilitates performance. We do not know what the limits of storage are in human memory. Under surgical stimulation people have remembered incredible things. We know we do have limits to accessibility and we definitely have limits to the amount of information we can process at any point in time. Now this is artificial, but I'm making it up for purposes of discussion. Let's say we have 10 units of processing space we can use. But I'm worried about something. Now, I can really get into worrying. I'm Jewish and have 4,000 plus years of history of worrying! Let's say I need six units to focus on my worry. If I want to do something that is not very demanding for me, I can do it while I am worried. When I am really worried my house is immaculate; it only takes one or two units. I can clean and worry with no problem whatsoever. But suppose the beginning of the semester is approaching and I need to be working on lectures. This takes a lot of concentration; maybe this needs eight or nine units. Now I have a problem. If I'm prone to high anxiety there is competition for processing space. Thus, one of the mechanisms by which anxiety disrupts performance is by diverting our attention. It diverts our attention from task-relevant thoughts and behaviors to irrelevant thoughts and worries.

We can do many things to help folks who worry. Let me give you just one example. In one course we teach something called thought stopping. It involves learning to monitor what you're thinking and determining whether your thinking is task irrelevant. For example, we teach our students to just monitor what they're thinking every couple of minutes while taking a test. If they find they are focused on fears and worries, they tell themselves "STOP" and focus back on the test. It sounds very simplistic, but it really helps. We tell students, "You can worry; just don't do it during my test!" When we first started teaching this we had faculty from all over the university calling us and asking: "Dr. Weinstein, why periodically during my lecture do some of your students say "STOP," "STOP," "STOP!" We never thought to teach internalization...but we do now!

It is very important to discuss irrational beliefs with students. When I work with older students or women returning to school, I never talk immediately about learning strategies. I discuss with them what they are afraid of about coming back to school. So we get through things like, "How am I going to tell my kid I got a D on an English essay?" or "What's my husband going to think about this or that?" People are anxious to talk about irrational beliefs. You need to be able to identify them so that you can substitute more realistic self-talk for negative self-talk before you get into a vicious cycle. If people think, "I can't do it, I'm going to fail," that takes time away from both study and performance and, sure enough, they do not do well. Then they have confirming evidence and get even more frightened and anxious.

There are several ways that people teach learning strategies. One mode by which people teach learning strategies is direct instruction. These methods range from our course at the University of Texas which is a regular three-credit, elective course for students at the university, to workshops at learning centers, focus groups, and all sorts of variants. In all of these the contexts, the content of the class focuses on learning and study strategies and skills.

The second method is what we call the metacurriculum. This is when instructors teach learning-to-learn as part of their regular content teaching. The metacurriculum can be done in either a planned or an unplanned way, or a combination of both.

A planned approach involves identifying

certain times in the semester to spend time talking about learning-to-learn. For instance, the beginning of the semester is an excellent time to talk about how to read a textbook. When you assign a long-term project, it is a wonderful time to talk about time management. We have discovered that a better time to talk about tests is after, rather than before, the first test. People are much more interested in what you have to say. Before the first test, by the way, is a wonderful time to talk about anxiety and its effects on performance and techniques such as thought stopping.

Unplanned times to implement the metacurriculum are those times when things happen in class on which you can capitalize. For example, you are teaching something and you come up with an excellent analogy that really works for your students. That would be a terrific time to talk about what an analogy is, how it helps students, and how they can use analogies on their own. Also, talk about transfer, how they can use the skill in other situations. When you assign practice exercises, tell students why you are doing it. Interviews show students think teachers use practice exercises as busy work. They have no idea that you may have any other reason for doing it.

One major problem in this area is assessment. How do you determine what your students do or do not know about learning strategies that are related to successful performance? We have concentrated part of our efforts on the area of assessment. When we began our course, we had nothing that could measure prior learning-to-learn knowledge and thus had great difficulty determining where students needed individual help. That is one reason why we developed the Learning and Study Strategies Inventory (LASSI). Basically, the LASSI is a 77-item self-report instrument that yields scores in 10 different areas that give students an idea of where their learning strategy strengths and weaknesses lie. It helps instructors place people who need some developmental education or develop ideas of what to stress in a metacurriculum. There are some methods that are far more important for math or for history than for science. LASSI provides summary sheets so people can see their strength or weakness on each scale.

Let me briefly go over the scales with you. The first is an Attitude Scale and this assesses students' general attitude toward college and how it fits with their other goals. Much work we do early in our course relates to goal setting. Many students cannot generate the motivation for academic tasks because they do not see how they fit in with their goals. For many students, the problem is that they don't have clear goals. When you get them to start talking about goals, they often mention things like a red sports car, a big house, a big dog. We try to help such students to re-examine or to establish goals and then to analyze what it will take to meet their goals. We also look at the relationship between long-term goals and short-term goals. The attitude scale starts to get at these things. A sample item on it is: I feel confused as to what my goals should be.

The next scale is a more specific one, the Motivation Scale. Rather than general interests and attitudes toward college, this gets down to the nitty gritty of going to school. Are you willing to show the diligence that it takes to go to school? Are you willing to do your homework and keep up with assignments? Do you go to class? When work is difficult, do you give up or only study the easy parts?

The Time Management Scale is fairly straightforward but really has two parts. One deals with what students know about time management; the second part with what they do about it. One can know time management principles but not actually apply them. Examples of items are: "I only study when there is the pressure of a test," or "When I decide to study I set aside a specific length of time."

The Anxiety Scale fits very closely with the concept of anxiety that I discussed earlier but concentrates on the worry aspect. Examples of items are: "I'm very tense when I study," and "Worrying about doing poorly interferes with my concentration."

The Concentration Scale also looks at the two aspects we talked about before, that is, those things that the students do to help

themselves concentrate and those things that they do that may distract them. For example, "During lectures I think of other things and don't really listen to what is being said." That is a sample item from this scale.

The Information Processing Scale has many pieces to it. It looks at elaboration but also has some comprehension monitoring and some reasoning items in it. Actually, it concentrates primarily on elaboration and organization strategies. For example, "I translate what I am studying into my own words."

The scale on selecting ideas is fairly straightforward. This really asks if they can pick out the important information for further study.

The Study Aides Scale is another one that has two parts. One part assesses whether students know how to use study aides that are provided. This includes review sections, markings in a textbook, and review sheets. The second part asks if they can create study aides for themselves. It looks at text marking, underlining, and creating review sheets. For example, "I use special helps in my textbooks such as italics and headings," or "When available, I attend group review sessions."

The Self-Testing Scale reviews much of what we talked about in comprehension monitoring, testing yourself, and testing your understanding. For example, "I stop periodically while reading and mentally review what has been said."

Finally, there is a Test Strategy Scale. It has items about how people prepare to take tests and items about what they do during a test.

If you look at the instrument and pull away the blue sheet, you will see that the student's marks transfer onto the back sheet and thus it is self-scoring. The LASSI takes approximately 20-25 minutes to complete and score (there are also computer- administered and scored versions for the APPLE and IBM PCs).

There is much that remains to be done in faculty as well as student training in the area of learning-to-learn. Many professors will still say to me: "Why do we need to bother with this? What we need to do is help people learn content." I think that today many of you in adult education realize the need more than other groups of college teachers. People today change their jobs so many times that the Bureau of Labor Statistics indicates five to seven job changes in a lifetime is not unusual. We are really helping to prepare people for lifelong learning. It is extremely difficult, as college instructors and professors, to justify our existence based on the transmission of set content in history, or English, or science, or in any area. We need to teach content but we need also to help students develop the ability to manage their own learning. We need to help develop the skills and strategies that they need to take more responsibility for their own learning and to be able to manage it.

There's an old expression that says, "If you give a person a fish, you've fed them for a day; if you teach them how to fish, you've fed them for a lifetime." I hope that we define at least part of our job as college faculty as helping people learn how to fish.

Reaction to Presentations: A Panel of Adult Education Professors

Huey Long, Sharan Merriam, Burton Sisco, and Chere Coggins

Following the presentations of Robert Sternberg and Claire Weinstein, four members of the audience, all professors of adult education, took turns commenting on ideas that struck them as they listened to the presenters. The purpose was to give focus to further discussions of intelligence and learning strategies. The four adult education professors were: Huey Long, University of Oklahoma; Sharan Merriam, University of Georgia; Burt Sisco, University of Wyoming; and Chere Coggins, University of Wisconsin. Rodney Fulton of the Kellogg Center, Montana State University, acted as moderator.

Huey Long: What I have tried to do is take a convergent perspective and see what is common to both the topics that were discussed today. I've moved from Sternberg's ideas of intelligence to Weinstein's learning strategies to the realization that one definition of intelligence is the ability to learn.

Both speakers presented what I considered to be distinctive ideas and I believe it is helpful to consider the relationship between intelligence and learning ability. Analytically, which causes which is not always clear. In fact, both presenters provided information that suggests that intelligence and learning ability interact. The underlying mechanisms of genetic, physiological, and sociological aspects remain unclear, however. Sternberg's theory illustrates a point developed by Gilford that intelligence may be conceptualized as a multifaceted phenomenon. Similarly, learning also seems to be composed of a number of subprocesses. How these subprocesses are controlled, how they are evoked, and how they are reinforced to yield an Alice, a Barbara, or a Celia remain to be elaborated.

The idea of different kinds of intelligence, as suggested by Sternberg, legitimizes what adult educators have been suggesting for years. Also, Weinstein's emphasis on learning-to-learn is to be found in the central core of most adult educators' philosophies. Certainly it does not detract from either of the presentations to note that similar ideas are found in the literature of earlier years. Sternberg's comments on flexibility of intelligence recalls to mind Milton Rokeach's, "Joe Doodle Bug Problem" and his "Theory of Dogmatism." Weinstein's comments are not unlike some of the observations of John Flavell and Robert Gagne concerning metacognition. Perhaps, neither are these concepts greatly different from some of the ideas concerning self-directed learning. For example, I am of the opinion that the only necessary and sufficient cause for self-directed learning is what I call psychological control, meaning personal control of the executive controlled process mentioned by Weinstein.

An important point for adult educators is the role of the instructor or teacher. I think both speakers indicated that this role is larger than the telling and giving of assignments. We have a challenge to provide environments in which the adult learner can develop a broader array of intelligence and apply a repertoire of learning skills. For example, one of the questions often asked relates to what William Kilpatrick called "three kinds of learning," that is, primary learning, associated learning, and attendent learning. Often what we find in schooling is an emphasis on primary learning with neglect of associated and attendent learning. I think this may be what contributes to the development of an Alice. If we could be a bit more sensitive to the associated and attendent learnings, perhaps we would also be more confident in contributing to a well-rounded individual that would have the strengths of all three of the kinds of people that Professor Sternberg illustrated for us.

I also find the same phenomenon illustrated in other areas. Ian Mitroff's study of Apollo scientists revealed that among these scientists there was a clear distribution of these scientists on a kind of reputational poll. There were some that were exciting

speculators, grand conceptualizers; there were some that were in the middle; and there were others toward the end of the continuum that were extremely limited by the data. They would not go beyond the data in interpretation and analysis.

I wonder how often we stifle creativity and restrict the development of a Barbara or a Celia because of the ways that we make assignments in our classrooms or courses, the kinds of things that we reward. The thing that I would come back to, in terms of looking at what both these presenters have suggested to us as adult educators, is that what is important for us is to examine our roles as instructors or teachers to be aware ourselves of what we reward and to be sensitive to the kinds of ways that we interact or intervene in the learning activities of the students with whom we work.

Sharan Merriam: My comments really take a slightly different bend than Huey's. When I thought about how I might comment on the two presentations, what came to mind was how this information intersects with what we have in adult education in various ways and how some of the information is congruent with some of the information we have used. It may be called by different names in our own field, but some of what we heard can also perhaps give us slightly new ways of looking at some of the same problems.

To begin with, one thing that came out in both presentations that is a central credo in our field is the importance of the adults' prior experience. One speaker talked about the importance of prior experience, not just having it or not just the amount of the experience, but the ability to use it. The other speaker talked about the importance of prior experience and learning from prior experience. We know the importance of experience in adult education and how we like to use adults' prior experience in classroom activities and in practice. But maybe we should be thinking about not just the fact that adults have more experience than pre-adults, but what about that experience? How has it been used and how have the adults learned from it? I think we can talk more about ways to extract that kind of information rather than just the fact that they have prior experience.

Another thought that struck me this afternoon was that the areas which we like to claim as important in our field are self-directed learning and, of course, the learning-how-to-learn work that Bob Smith is doing at Northern Illinois. The aspect of self- directed learning that was interesting to reflect upon was the self-assessment that Claire talked about and how we say that adults are capable of not only directing their own learning but of assessing their own learning. In reality we don't let them do that very often. Perhaps we can take some of the techniques that she mentioned and begin to apply them more rigorously in terms of letting adults do their own self-assessment.

In her discussion of self-assessment, cooperative learning was also interesting. We know, back from a time in the 40s and 50s when groups were so popular, one of the models was adults teaching adults and adults learning with adults, that cooperative learning is one of the mainstays of our field. I think that most of us here use that model extensively in our teaching, but I don't think we use it in terms of self-assessment. Perhaps we could think of ways to integrate it into self-assessment.

A third area that intersects with things going on in the field right now was the reference by both speakers to expertise versus novice. I know that Ron Cervero and other people interested in continuing professional education are working with the notion of expertise and what is an expert continuing professional educator. What is an expert program planner in our field? What constitutes expert knowledge? How does one get to be an expert? Some works, such as *Reflective Practitioner*, are tied up in the exploration of this area.

We also have some interest, at least in our university, in looking at the translation of expert knowledge such as expert computer systems. How does one get knowledge from an expert and translate it into what is called one of the expert systems in the computer world? We have a couple of doctoral students doing

dissertations on that at the moment.

The last point that struck me is that inherent in both presentations was the notion that the learner is the key aspect. As a field, we like to think of ourselves as learner centered. But in both their orientations the learner is not just the outcome but is also a part of the process. Attention to the learner and what the learner brings to the situation--the types of intelligence on one hand and the types of experience on the other hand--is as important as the outcome in a learning transaction.

I would like to see more discussion from both of our speakers on how they see the adult's life situation as being different than your traditional college-age student. This strikes me as sort of acontextual. Those of us who deal with adults on a daily basis know that some of the factors in their learning are very much context-bound, life-situation determined. I would like to see more addressing of those issues and how adults' learning and intelligence may or may not be different from what I would call pre-adult or traditional college-age students.

Burton Sisco: I think it was Burt Kreitlow, in a book entitled *Controversies in Adult Education*, that described adult educators as a rather contentious lot. It remains to be seen if both Dr. Sternberg and Dr. Weinstein describe us that way. It seems to me that what they have provided is some further kind of confirmation about things such as human intelligence and learning that will make us even more renegade-like. A number of us have been very uneasy about the overemphasis on analytic types of intelligence, or componential intelligence, according to one aspect of the triarchic theory Dr. Sternberg describes. I learned recently, when I sat through a workshop on social style, that I'm an expressive; therefore, I tend to mix facts with emotions. I suppose it's in that vein that I've been very uneasy with our toleration, for example, with the normal curve. I know there is great statistical veracity for that, but for me that just tends to acknowledge mediocrity, our overemphasis on testing mechanisms, and the idea that IQ tests are somehow free from bias--be they social, cultural, gender or so forth.

I'd like to relate Dr. Sternberg's work to my own graduate students as he was describing the three individuals, Alice, Barbara, and Celia. One of the connections that I have made is that certain graduate students seem to possess marvelous talent, do marvelously well in the classroom, are very punctual in terms of their papers, and write really good papers (and I don't want to define that but I think that most of us would tend to agree they're literate). Yet, as we move through the process from knowledge acquisition and technical competence to the higher levels of thinking where we get into synthetic analysis and evaluative thinking, we begin to note some problems. We pose questions in qualifying exams in a way that will enable our students to begin to synthesize, bring information together, and yet certain students have trouble doing this. At the same time, we have other students who are able to bring that together beautifully. We then move to the dissertation stage and, again, some students seemingly have greater difficulty conceptualizing a problem, working that problem out, figuring out a method, whereas others seemingly have no problem whatsoever.

Personally, this is an area that I might suggest could be looked at in more detail. Has there been research that has looked at the phenomena of those who succeed in graduate study and those that don't? And, in fact, can we explain that in the context of the triarchic theory? It would seem to me that as we move students through the process of graduate study, we certainly do a good job with the analytic or the instrumental learning; even prefer it. But perhaps the practical intelligences, the street smartness, the idea of creativity and novelty, the idea of becoming more self-directing, we do less well there. It would seem to me that Dr. Sternberg's triarchic theory may, in fact, help us to begin to account for this confounding situation.

Another observation has to do with a very logical connection, as Sharan mentioned, with some of our own research in adult education. There have been some writings, particularly in

the area of self-directed learning, where people have tried to understand the phenomena in greater detail. Out of this has grown another kind of triarchic explanation. Instrumental learning is described (and this is based largely on the work of Habermas) as where we learn to manipulate the environment and typically involve the cognitive skills of knowledge and comprehension. On a second level, and that's the dialogic or communicative learning, we come to understand what each other means. Thirdly, the self-reflective area which seems to be very experiential and includes the idea of not only acquiring experience but also utilizing that experience. It seems to me that it might be fruitful for us to see if we can find some logical connections between what some have said is unique to adulthood (communicative and experiential forms of learning) and Dr. Sternberg's triarchic theory of human intelligence. Perhaps there is also a fruitful relationship to Dr. Weinstein's work as well.

I am curious; has the triarchic theory been tested? Is there empirical veracity to support its claims? I would like to leave that as a question at this point. Also, how, in a practical way, can we further integrate it in the context of adulthood?

In the context of Dr. Weinstein's emphasis on the learning-to-learn concept, I believe we must avoid sloganism and quick fixes. I feel somewhat relieved that she has not done that. It would be comforting to learn more background of the development of the LASSI test and how to operationalize some factors that she considers to be key elements in the context of learning-to-learn and learning performance, especially for adults.

It seems to me that it might be useful if we could also transfer the emphasis on learning-to-learn to learning to teach. Most of us teach as we learn, at least that's what a lot of the research has suggested. The whole area called "learning style, or teaching style, or instructional effectiveness" is very appalling in the context of adult education. There too might be some very fruitful areas in the connection between general kinds of strategies, or executive processes that cut across any discipline or any presentation, and those that are more subject-specific.

Finally, the notion of fluency and flexibility is very tricky for me. The reason is that it seems to begin to account for a dimension that describes those individuals who are seemingly very effective at learning in a general or practical way and less effective in classroom situations. It evokes a continuum that I think we need to study more, and that's the notion of versatility. What we really ought to be teaching or what we ought to be working toward is certainly the rudiments of what might be termed learning-to-learn, but more so in the context of helping students become more versatile and flexible in their learning.

Chere Coggins: I took a different tact because I'm such an affiliative learner without anybody to talk to, all I could do was raise questions, not answer questions.

I was struck with Alice and struck with the fact that Alice could pass the Graduate Record Examination (GRE) exams and get wonderful scores and I sat back smugly and said, "I come from an institution where we don't use GREs and we don't use Scholastic Aptitude Tests (SATs)." I thought to myself, how can we as adult educators stand up and talk about the need for cultural diversity in our field yet use exams that do not allow for cultural diversity? How can we talk about the value of background and experience and the diversity that we as adult learners have, yet give a test that requires a particular set of experiences, a specific background? How can we talk about that fact that adults probably have a tendency more toward reflection than impulsivity, that they don't work quickly but they want to be perfectionists, that they probably would have skipped the last five questions rather than be embarrassed by guessing, yet we ask them to take a timed test. We know adults have a tendency to be test anxious, yet we say, "Hey, listen, if you pass, if you get a good score of 40, we'll let you in." So I raise the question, how can we as adult educators require in good conscience the kinds of tests that we insist students take who enter our programs?

As I thought of Barb and those people

who stand in judgment of her, those who had expectations relative to what a person with a good GRE test score would be able to do relative to somebody with a lesser test score, I started to think about the whole role of expectancy. In our research with distance learners, we discovered that one very telling variable is expectancy. Those who say, "I don't think that I'm going to do well," don't do well. What role does expectancy have on the completion of degree programs, courses, exams? My bigger question relates to where does this expectancy come from? What pieces of information do people pull together to determine whether or not they should expect to do well or expect to do poorly? Expectations of others? Test scores?

I have questions about Cecelia's contextual intelligence. It seemed to raise the question of socialization, in learning abilities, in reading or sensing contexts, in repertoire development. I was also struck with Bob's discussion of verbal and nonverbal communication because some of my work is in distance education. I started to get concerned and raise questions in my mind about multimediated education. How do you know I'm smiling when I send you a message on E mail? How do you know I'm really being sarcastic when I send you this little cryptic note? How do we deal with the nonverbal communication when we deal with so many media as we deliver education to adults at a distance?

Also, when we talked about psyching out professors and students working on problems different than we thought they were working on, it reminded me that as we do our experiments and have measurement issues to deal with, how do we know that all the subjects in our experiments are dealing with the same problem? How do we know they're all defining it in the same way? What does that do to our research results? What about the inaccuracy of context reading where many of our students assume that we're only looking for surface details. They don't understand the expectations are deep learning. I believe that Claire spoke to that earlier. We have to be very clear about our expectations.

Bob talked about being over-proceduralized as learners. Those who become expert learners, those who have really excelled in elementary and secondary school, perhaps are at a great disadvantage. They have excelled by following the instructor wherever he or she may lead. In other words, they have really accomplished wonders in being socialized into a role that we expect them to drop when they come to college. At the college/university level, we expect them to take on responsibility; yet, they have not been socialized to do that. They've been over-proceduralized to do something else. What is needed to make that paradigm shift? What role does outlining expectations from the outset of the class have? Can we instigate perspective transformation? There are some positive things to be said about being over-proceduralized too. As Claire talked about the anxious students, those who got so anxious that whatever learning skills they might have had went right out the window, I wondered how do we over-proceduralize so that no matter what you do to me--if I'm only banging on two units--those learning skills are at the same level as Claire's vacuuming and compulsive housekeeping. No matter what you do to me, I will still have learning skills so ingrained that I'll be able to rise above whatever.

Sharan focused on self-assessment; that was another theme that struck me. Bob talked about shapers. How do we foster thoughtful reflection on our own study skills, our own learning skills, so each student can determine their own strengths, their own weaknesses, and begin to remediate or to compensate where necessary.

I also wondered about knowing what you know and knowing what you don't know. Oft times we're so busy running around we never take time to think about that. Also, Claire had mentioned depicting knowledge and depicting relationships, and somehow that all fit together to me. In my free association I turned to thinking about different kinds of knowledge and branched out to concept mapping. I wondered what difference it would make if I said to my students at the outset of the class, "Try to map out what you know

about the concepts that we're going to be discussing in this class. Let's map out the major concepts and the related concepts." What difference would it make if we had students become very conscience of what it is they know and what the value of that experience is which they bring to the classroom? What value would it be to ask them to go through the same kind of activity half way through the class, to take a look at that old concept map and say, "Gee whiz, it looks really different. Now it should look like this; plus I've added that and that and that"? What difference would it make to the nature of their learning, the depth of their learning, the retention of that learning both long term and short term? What difference would it make if a concept map was the last thing they did in class, something that might give them some thoughtful self-evaluation, an opportunity to see where they had come from over time?

I was intrigued last week with peer tutors. Those of us who work with distance education students are always looking for ways to help people, and tutors are always one way. I think the sharing role of the peer tutor is wonderful; we usually talk about the one way tutor role. Sharan helps me; Sharan grows; I grow a little bit, but Sharan grows a lot. I really was intrigued with the back and forth situation. I also recalled research by Dan Coldeway up in Athabasca University that showed that peer tutors, when tutoring ten or less students, could accomplish as much as an expert. That's something to think about.

Lastly, contextual factors are very important, particularly for learners who are learning at a distance, because their context really impinges upon them. Their classroom is the kitchen table in their jammies and slippers at two o'clock in the morning. What difference does that context make? Lots of questions; I look forward to answers.

Real Life vs. Academic Problem Solving

Robert J. Sternberg

The definition of intelligence and the measurement of it through typical IQ tests should cause some real concern for adult educators. There is very little similarity between what these tests measure and the problems adults face in their lives. Adult educators who base their theories of learning on traditional definitions of intelligence or build programs on such concepts are in trouble, just as people who solve problems in real life the way they probably were taught to solve problems in school get into trouble.

What I want to talk about today is the difference between everyday problems and academic or test-taking problems. And I want to start with the idea that in real life you have to learn to recognize problems. Usually nobody is going to come along and tell you that you have a problem--at least not until it is too late to do much about it. In school, a teacher may say, "Here is a problem to work on," but that is not the case in the business world, for example.

If you look at the automobile industry back in 1974, the only foreign cars on American streets were Volkswagens, plus a few Mercedes or rich-people cars. After 1974, suddenly there were Hondas, Mazdas, Toyotas, Nissans, and so on. What happened? Very simply, Japanese car makers recognized a problem that Detroit auto makers did not recognize; namely, that the point would come when oil would be scarce and people would want smaller, more fuel-efficient cars. Detroit, to the contrary, for years had been successively upsizing cars because "the bigger the car, the bigger the profit." The Japanese recognized the problem; the Detroit auto makers did not.

It's not enough just to recognize problems; you have to be able to define them. If you don't define them correctly, you've got a real problem. My brother faced an example of problem definition. Some years ago, he lived in a house in Virginia, and right by the house was this big box elder tree. The actual problem was thousands of disgusting, little brown box elder bugs all over the house. He was not able to tolerate the bugs, especially when the weather cooled off and they started to come inside. What do you do with this very real-world problem?

This is a situation where problem definition is key. There are a number of ways to define the problem, and the way you define the problem is going to determine the solution. So what could you do about the box elder problem? You could cut the tree down. If you do that you're defining the problem as the tree. As soon as you define the problem as the tree, the solution immediately follows that you cut the tree down. But it turns out that there are problems with that definition of the problem. If you are careless, the tree might land on the house. You begin to realize that the tree was a nice shade tree. You also realize that there are other box elder trees in the neighborhood. If you cut one down, you still have the others. In this case, most importantly, the tree was not on his property. Anyway, to cut down the tree does not turn out to be a useful definition of the problem.

What else could you do? Calling the exterminators was actually what I suggested. That turns out to be another way of defining the problem, in other words, defining it as the bugs. But that definition also has problems. The bugs come back two months later. Another problem is the kind of poison they use is fairly toxic, and my brother didn't want his kids zonked. The exterminator solution, based on defining the problem as the bugs, also has problems.

A better approach is to define the problem as the house. One possible solution that follows from defining the problem as the house is to move. That seems to be problematical for the obvious reason. No one wants to buy the house given the way it looks. If you define it as the surface of the house and change the surface, in this particular case, that turns out to be the optimal definition. It

turns out that my brother noticed that all the houses that had box elder bugs were light colored; all the houses that did not were dark. He painted the house brown figuring that either it would get rid of the bugs or he would not see them anymore, and, in fact, that got rid of the bugs. But the point to the story is that no one defined the problem for him. He had to define it himself.

Another example is what happened to the United States during the Nixon administration. Remember the Watergate fiasco where some burglars broke into the Democratic Headquarters in the Watergate Hotel and stole documents? Regrettably for them, they got caught. Nixon had a problem and the way he defined the problem would be absolutely critical to his career. In many respects he was intelligent and his advisors were wise in solving problems; in defining this problem they were not so smart. What does that mean? The way they defined the problem was this terrible thing happened, and it is leaking out. What we have to do is contain the damage by plugging leaks. If you question whether they actually defined the problem as one of plugging leaks, remember there was a group of people working for the Committee to Re-elect the President who were called the "plumbers." Plumbers plug leaks. If you pursue the metaphor further, you know that if there is enough water pressure, eventually the dike gives way. That's exactly what Nixon found. Even though he tried to plug the leaks, there was so much pressure that everyday there was another revelation about what was going on. Eventually Nixon was forced to resign, not because of the burglary, but because of the coverup. In my view, it was because of the inappropriate definition of the problem.

It is another real-world example in which people do not define the problem for you. I would argue that there was a much better definition of the problem than the one Nixon used. The better definition was to admit what happened and get it all out. People accused Nixon of being Machiavellian, but in *The Prince* Machiavelli said: "If you have bad news, tell the people all at once. If you have good news, dribble it out slowly." Nixon had bad news and he dribbled it out slowly. Some might say if he admitted it all at once he still would have had to resign. But I want to argue that there are several recent examples where people did use the Machiavellian principle, and it worked out fine.

A few months ago it was discovered that Chrysler executives were using new Chrysler cars for their own personal use, and after they used them the odometers were turned back and they were sold as new cars. In some cases the cars had been wrecked. They were repaired and still sold as new cars. Unfortunately for Chrysler, it gets out. So what do you do about this embarrassing incident? One possibility is to try to control the leaks. Iacocca chose the opposite. He took out full-page ads in major U.S. newspapers, admitting that they had goofed, that they were embarrassed, and that it would not happen again. After a few weeks, no one was talking about Chrysler rolling back odometers on cars.

A more serious example was the Tylenol fiasco. You may remember that a few years ago somebody decided to lace extra-strength Tylenol with a permanent cure to headaches. As a result, a lot of people did not want to buy Tylenol anymore because they weren't looking for anything that long-lasting. The Tylenol company, Johnson and Johnson, now had a problem. They could have tried to cover it up. Instead they chose to admit the problem and recall all Tylenol. People said they were crazy; Tylenol was the leading selling analgesic in the United States, and no one would ever buy Tylenol again. What is the leading selling analgesic in the United States today? Tylenol.

So, again, the definition of the problem is more critical in many ways than the way it is solved. But, if children are taught that they are always going to have problems defined for them, as is done often on tests or in school, they are not going to be ready for practical problems.

What I have been arguing is that two of the things that schools are doing, pre-recognizing and pre-defining problems, do not work outside the school setting. A third difference between everyday problems and what is being

taught in schools and in testing situations is the issue of structuredness of problems. I want to introduce this by telling you a story that happened to me as an adolescent.

A newspaper had an advertisement for handwriting analysis. I had fairly unusual handwriting, so I decided to send away for a $10.98 handwriting analysis. A couple of weeks later I got back the handwriting analysis. Some of you probably believe that there is nothing to handwriting analysis, but I wasn't sure what I believed. To my astonishment, the analysis was really good. It wasn't like the crystal ball gazers where they say things about you that make you feel good but which could have been said about anyone. Rather, the analysis said things of me that would not be true of other people, things that the person could not possibly have known except by analyzing the handwriting. They said things like I have unusual leadership abilities though I'm not always given an opportunity to exercise them; I'm creative although people don't always recognize this; I'm compassionate and caring of other people!

The questions this raises is, how they could make a profit doing this for $10.98 per throw? It turns out there was a little message in with the handwriting analysis which said: You will notice that you have a favorable personality structure, but that there are a few things that you may want to improve about your personality. We will help you do that if you send $69.95. We will give you handwriting lessons and, by changing your handwriting, give you a better personality.

The logic in this example is similar to the logic we use for increasing children's or adults' intellectual skills. What we do to make people smarter is basically what is recommended in the handwriting story. That sounds sort of odd so let me say why I believe that that argument is correct. When people first theorized about and created intelligence tests, they did not believe that what you find on intelligence tests is the stuff of intelligence. To the contrary, Benet and Wechsler said that intelligence is the ability to adapt to the everyday situations. The tests are an index of that ability. It's like a thermometer; no one really believes the thermometer has the heat itself; it is only an indicator of the heat. A fever is not a disease; it is just a measure of that disease. The analogy is if you give the person aspirin, you may reduce the fever, the symptom, but you would not be so foolish as to say that you are getting rid of the disease. You don't cure a virus by giving a person aspirin; you just lower the fever.

Similarly, increasing scores on intelligence tests does not increase intelligence. You change the assessment, the index measure, not the intelligence itself. Obviously it's not bad to increase scores on intelligence tests. If you want to get into college or graduate school you need high scores on tests. It would be an innocuous business if that's all there was to it, but in some cases, what is required on the intelligence tests may actually go against real-world intelligence. Then what you may be doing is teaching people skills that do not work outside of testing and some academic situations. Recognition of problems and definition of problems are two examples. The third is structuring of the problems.

IQ tests, achievement tests, and academic problems tend to be well-structured. There is a path, and if you follow that path, you're guaranteed a solution. There has to be, or people would complain to ETS or Psych Corp that it is ambiguous. Teachers worry about giving problems that are too ambiguous; how do you score them? Despite the fact that test problems and most academic problems are well-defined, very few real-world problems are defined. For example, the problem of improving your personality is not solved by changing your handwriting.

The best selling book you can find is called "Ten Easy Steps to..." In fact, of all the books I've written, the most successful has been *How to Improve Your Score on the Miller Analogies Test*. Why? Because it listed ten easy steps on how to improve your scores on the Miller Analogies Test. Look at the best seller list; you'll see books on how to lose weight, how to stop smoking, and so forth. The fact is that they do work. You do lose the weight for a week and then you gain it back. You stop smoking for a week and then you

start again. Things do not work on any long-term basis. There is a very simple test that absolutely proves I'm right. The books keep selling and new books keep appearing. But if any of it worked, you wouldn't need new books. There would be one method, and people could use it to lose the weight or stop smoking once and for all.

Real-world problems are ill-structured, not well-structured. Teaching children or adults to be smart by solving well-structured problems is a disservice because that's not the way life is. It teaches them to look for the "ten easy steps solution" and then to fail again and again. Another difference between test and academic problems and what you find outside of a school setting is contextualization. Problems on tests are decontextualized.

Similarly, problems in textbooks are all unrelated to each other. There is very little information in any of the problems. You're supposed to solve the problem on the basis of three or four sentences, sometimes less. Real-world problems are not decontextualized; they're contextualized. You can't solve them in isolation from other variables. If you're thinking about buying a house you can't solve it in three or four sentences. You have to take into account interest rates, house prices, what your spouse wants, your job, how much money you have. There are a lot of contextual factors that affect the decision.

Problems of any consequence in everyday life differ greatly from problems you find in school and on tests. You could say "Big deal!" if people solve decontextualized problems the same that they solve contextualized problems. There is much evidence that it is not the same at all. For example, psychologists built a theory of decision making on the basis of experiments done with poker chips. They had people choose poker chips; if you chose the right one you got three cents; if you chose the wrong one you lost two cents. By the end of the experiment a person might gain or lose up to $2.00. From this they built a theory of decision making. Then other psychologists asked people to make real-world decisions, and they discovered something very extraordinary. The whole theory of decision making built on poker chips worked only for poker chips.

When I worked for the Psychological Corporation we had a complaint about a college that was using the Miller Analogies Test for admissions. The school required a score of 25 for admission, which could have been the basis for a complaint because it is a 100-item test with four multiple choice options which makes the chance score 25. But the actual complaint was by a woman who was admitted with a score of 24 because her other credentials were so exceptional. Now that she has finished the program and is ready to graduate with honors, they do not want to give her the degree. Why? She did not get a score of 25 on the Miller Analogies Test. They asked her to retake the Miller Analogies Test. The predictor again becomes more important than the criteria to be predicted. This case had a happy outcome. The woman retook the Miller Analogy Test, got a 26, and was given her diploma.

This kind of thing is typical of talk about overachievers. I've heard it said that some person is an overachiever, not really very smart, but for some reason more successful than deserved. The whole concept is ridiculous because it is based on a very narrow measurement of intelligence. If someone does better than predicted by this narrow test, there must be something wrong with them. You do not have to fix the test; you have to fix them so that their performance is more in line with what is shown by the IQ test!

There is a fourth difference in the way people solve contextualized problems. I organized a study in which college students were given IQ test-like problems and also real-world problems. An example of a real-world problem is the following. Josh and Sandy were discussing two baseball teams, the Reds and the Blues. Josh said every member of the Red team is better than every member of the Blue team which proves the Reds are the better team. Is this conclusion valid? This kind of reasoning is called the fallacy of composition. The fallacy rests on the belief that the whole equals the sum of the parts. But any number of instances can be found where that does not work. George Steinbrenner bought the New

York Yankees some years ago and populated his team with the very best players for each position. The next few years they won few games. The players were good, but they could not work together.

A fifth difference between academic problems and real-world problems is that most school problems have one right answer. All test problems have one right answer. Very few real-life problems have one right answer. You cannot say, the right way to solve the Israeli/Arab conflict is...; or the right way to deal with an angry spouse is.... There are options that work better or worse, but there is certainly no right answer. Teaching children that problems have right answers may work for test problems, but not for many real-life problems.

A sixth difference between academic problems and everyday ones is that of relevant and available information. On a test, the information that will solve the problem must be found in the test problem or presumed to be known by the test takers. It would be nice to have it that way in life. Did you ever try to find a really good doctor--a surgeon or a specialist? How do you recognize a good doctor? Where do you get the information that would tell you who is a good doctor? Do you look at the medical school attended or the number of survivors of operations performed? Do you call the American Medical Association for a list of members of the Medical Association? The point is that in the real world it is not clear where to get the information or even what exactly the information is that you need.

The seventh difference is most easily illustrated by examining a very typical IQ test problem. The problem is sometimes called the 2-4-6 problem and it is on virtually every intelligence test. What the test taker must do is extrapolate the series. We'll take a simple series to illustrate the point. You are given 2-4-6 and you have to say what number comes next. The idea is that there is a series of 2-4-6-8-10-12-14 and a rule based on those numbers. The rule is increasing even numbers or numbers increasing by twos. If you write that answer on the test, you get it right.

However, increasing even numbers by two is not the rule that I have in mind. So that raises a problem; what is the rule I have in mind? Give me some more numbers.

"Twelve." Right, that's in the series.

"Fourteen." In the series.

"Thirty-six." In the series.

"Thirteen." Also in the series! Stop for a minute and think about the difference between 13 and 8-10-12-14-16-18. The difference is very clear. However, every number that you have here, except 13, tends to confirm what you already believed, that is that the series is increasing in number by two. But then I told you that was not right. Yet the first responses I got were more attempts to confirm what you already knew was not true. It usually takes people awhile to disconfirm a hypothesis which they now know is wrong. It took about 10 responses until someone suggested a number, such as 13, 7, or 11 that disconfirms what was believed in the first place. Does anyone want to guess what the rule is? Seven is good; 9 is good; 3 is not good; 11 is okay. The rule is simply increasing natural numbers. These three numbers 2-4-6, are three not particularly representative numbers from the population of increasing natural numbers. It happens that they are three even numbers; I could have used 2-4-5, 2-4-8, 2-4-10, 2-4-11. The important thought is that small samples are notoriously biased. Anyone who has had even one statistics course knows that. This sample happens to be biased toward even numbers.

Now, I am not really interested in that number series. What I am interested in is that what we learn in school is to accept a belief that we are given or to accept a fact on authority. When we're taught to think, we are taught to justify what we believe. What I want to argue is that that is inadequate. What happens as a result of such thinking is if you go to a Republican rally you become a Republican, but if you go to a Democratic rally, you become a Democrat. People seek out information to confirm what they believed anyway. They rarely seek out information that disconfirms beliefs, and we scientists are no better than anyone else. We do experiments to confirm what we already believe. How

often did I try to disconfirm my triarchic theory? The result is that we are not very good at disconfirming our beliefs and thus we have trouble not only understanding other people's views but even admitting another view is at all plausible. In the real world, we need disconfirmation as well as confirmation.

When I taught my thinking skills course last year to teachers from around the country, I gave them an exercise in which they were to take some belief they had, a belief that they were serious about and thought they could justify, and write it down. They, of course, thought the assignment was going to be to justify the belief. No, it was to argue against their belief in a convincing way. The interesting thing to me was that most of those well-educated teachers admitted having never seriously considered arguments for the other side. Again, there is a difference between real world and academic problem solving.

An eighth difference between the academic problem solving and everyday problem solving lies in feedback. In school settings you get clear feedback about what is right and what is wrong. You get C's and X's and checks; you get grades on papers; you get feedback that is quite explicit. Unfortunately, that's not what happens in everyday life. It is rare to get explicit feedback on how you are doing. For long periods of time on the job, feedback is not clear. When you're in a relationship with someone, it is rather rare to be given feedback directly from the person as to how the relationship is going. Usually it is not until things are pretty bad that the other person gives you the feedback. You know, "I'm leaving tomorrow," or "I'll pay you to leave tomorrow." Feedback in everyday situations is very muddled, if it is given at all. What we must learn is how to operate with incomplete or unclear feedback.

A ninth difference between the everyday situation and the academic situation is the emphasis given individual problem solving. The whole academic structure is geared toward problem solving by the individual. If you work on a test with someone else, it is cheating. ETS actually has uniformed security guards who go after people who collaborate. So what we learn is how to do individual problem solving. This is disturbing because very little real world, adult problem solving is individual. Almost always people either work with others to solve problems or get their solutions cleared by other people. If you can't convince superiors or committees that your solution is a viable one, no matter how good it is, that is the end of it. In everyday life, very good solutions go down the drain because people cannot convince others that the solutions are good.

Individual problem-solving skills do not transfer well to group settings. In fact, sometimes you get negative transfer. An example for me was the first faculty meeting I went to as an assistant professor at Yale. All these faculty members were outstanding individual problem solvers or they would not have been hired. But the faculty meeting was like a circus. There were people who were grandstanding; nobody was listening; most were busy preparing their own arguments. It was clear that these people did not know how to work together. There have been many other settings that I have been in since then where the same thing happened. In politics you get incredibly poor decisions by smart people. How can people who are so smart, who are well trained, come up with stupid solutions? The answer is something called "group think." Smart people get together in a group and succumb to group decision making. An example of "group think" is the formation of "mind guards." Someone in a group assumes the job to ostracize or at least criticize people who do not go along with the group. It happens in every kind of organization all the time. If you do not go with the group, slowly you are edged out of it, and eventually you lose whatever power you once had.

So, I think the meaningful challenge to adult educators is to help adults try to solve their real-life problems. The kind of problems you find in test-taking or academic situations are usually not real problems and certainly are not presented in the same manner in which they occur in everyday life. I hope the ideas I shared with you today help you do that.